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Making Three 24-in. Connection Cuts in a 60-in. Steel Water Main under Pressure, Pittsburgh, Penn.

By Chas. A. Finley*

It rarely happens that it becomes necessary to connect two 60-in. steel water mains, and at the same time keep the pressure in one of them. This was the problem encountered by the Bureau of Water of Pittsburgh, Penn., in March, 1914, and successfully solved by making three 24-in. cuts in the old main while under pressure and connecting as many branch pipes of that size with a three-way special provided at the end of the new main. The circumstances which led to this job and the details of design and execution are stated in the following text, which is supplemented by a plan and section and two halftone views of the connection.

*Superintendent, Bureau of Water, Pittsburgh, Penn.

Prior to the latter part of April of this year, the North Side of Pittsburgh (formerly Allegheny) had never enjoyed the advantages of filtered water. Up to that time it had been supplied with raw water by a 60-in. steel rising main from the Montrose Pumping Station, situated on the right bank of the Allegheny River, some miles above the city limits.

Going back a few years, it may be noted that after the consolidation of Allegheny with Pittsburgh, in 1907, measures were taken to remedy this condition. These measures necessitated the expenditure of $2,500,000, and embraced the erection of a new pumping station near the Pittsburgh Filtration Plant at Aspinwall, for supplying filtered water to Allegheny, the laying of some 1200 ft. of 60-in. riveted steel pipe connecting the Aspinwall Station with the 60-in. force main from Montrose at a point near the western confines of the Filtration Plant and, in an air line, 1050 ft. northwest of the Aspinwall pumping station, and the construction of a new storage reservoir.

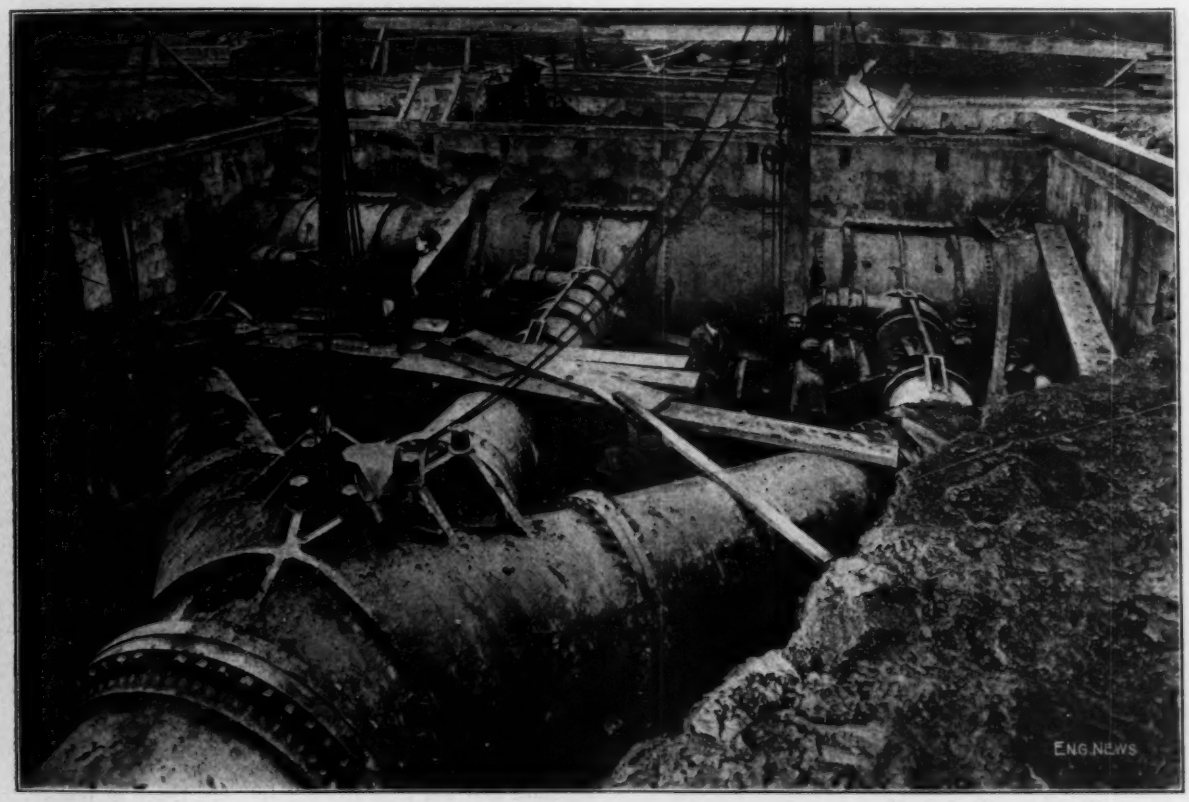


Fig. 1. Making the Second 24-In. Cut in 60-In. Steel Water Main under Pressure, Pittsburgh, Penn., Looking North

(Three-way special in foreground; Smith tapping machine in right middle ground; central connection already made; third connection, on left, not yet started.)

Owing to the available storage on the North Side being insufficient to permit throwing the Montrose force main out of service long enough to connect the two mains by a 60-in. bend, recourse was had to three 24-in. cuts in the Montrose main, all made under pressure and connected to the new Aspinwall main by means of a special three-way casting. (See the plan and section, Fig. 2, and the views, Figs. 1 and 3). Each of the 60-in. mains is riveted steel, ½ in. thick.

Prior to the cuts being made the pipe was uncovered and inclosed in a reinforced-concrete vault, 14½x34½ ft. in plan. The roof and south wall were left off until after the pipe cuts were made. Concrete supporting piers and backing blocks at the point of each cut insured stability during the cutting operations.

The main was next encircled by three heavy cast-steel sleeves 4 ft. wide and 11 ft. 8 in. c. to c. Each sleeve was in two sections, provided with flanges held in place by twelve 1¾-in. nickel-steel bolts at each joint and made tight by means of lead gaskets ⅛ in. in thickness.

Owing to the flexibility of steel pipe and the possibility that the section in question might lend itself readily

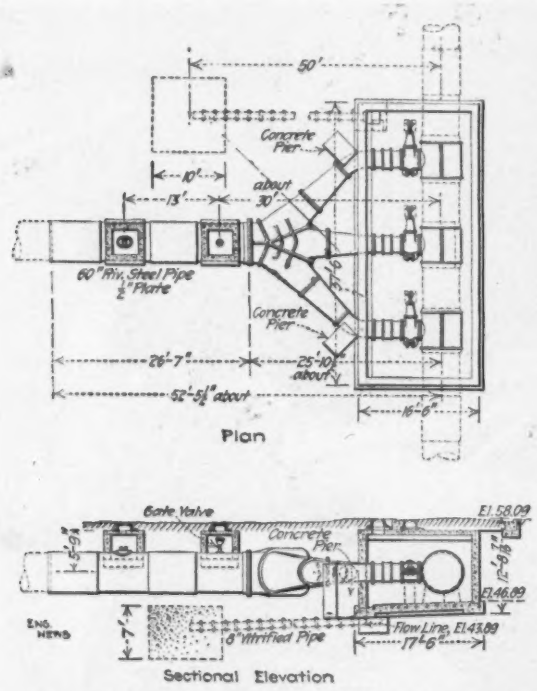


FIG. 2. PLAN AND SECTIONAL ELEVATION OF CONNECTION BETWEEN TWO 60-IN. STEEL WATER MAINS, PITTSBURGH, PENN.

to distortion during calking some apprehension was entertained as to the possibility of obtaining satisfactory lead joints and in consequence special care was exercised to insure as neat a fit as possible between the pipe and the sleeves. The sleeves were poured solid throughout, 2500 lb. of lead being required for each. All joints were painstakingly calked by experts, special attention being given to the area immediately surrounding the point of cut.

Flanged openings were provided on each sleeve to which were bolted special gate valves. Valves and openings were slightly in excess of 24 in. in order to allow for the cutting of a disk full 24 in. in diameter.

The valve being opened the cutter was inserted against the pipe and held in place by a cutting back, bolted to the valve through a stuffing-box from which the stem and gears protruded for operation. A 1½-in. drill preceded the main cutting tool a sufficient distance to penetrate the pipe before the 24-in. cutter was engaged, allowing the full pressure on the sleeve and gate and permitting of any additional calking found necessary before proceeding further. No particular difficulty was experienced in this respect, however, but had occasion demanded, the machine was equipped to tap and plug the 1½-in. hole, permitting the removal of the valve and sleeve without dan-

FIG. 3. CONNECTING 60-IN. STEEL WATER MAINS AT PITTSBURGH, WITH MAIN UNDER PRESSURE; LOOKING SOUTHWEST

(Note flanged and bolted sleeves for use in tapping in the three 24-in. connections.)

ger. Some minor leaks developed but were readily made tight and the cuts expeditiously completed.

The cutting machine was operated by hand. An average of five hours was required from the beginning to the completion of each cut, including the removal of the piece cut out.

The method employed to hold the cutting machine rigidly in place during the operation is shown by the views (Figs. 3 and 1), the extra heavy pipe being in compression and the rods passing through them in tension. After completion of the cuts and the installation of the 24-in. make-ups, consisting of two flange and spigot pieces and a leaded sleeve between each valve and the three-way casting, these members were removed.

The cutting machine and castings were furnished and the cuts made by the A. P. Smith Manufacturing Co., of East Orange, N. J., under the direction of the Bureau of Water, Mechanical Division, of which C. O. Daughaday is Division Superintendent. F. W. Lyon, Division Engineer, was in immediate supervision of the work and T. R. Tarn, Division Engineer, was in charge of design.

Track Plans for Stations on Single-Track Railways

By G. P. De Wolf*

Among the important features in the design of the track layout at stations on single-track lines are the facilities for handling local freight traffic without obstructing through trains. In my 27 years of railway work (which have been pretty well distributed between construction and maintenance-of-way, with some experience in conducting transportation), I have given considerable study to conveniences for getting trains over the road, but it has been my observation that little attention has been given to this subject and that few roads appreciate the saving that can be made by a little care in the arrangement of tracks and conveniences at small stations.

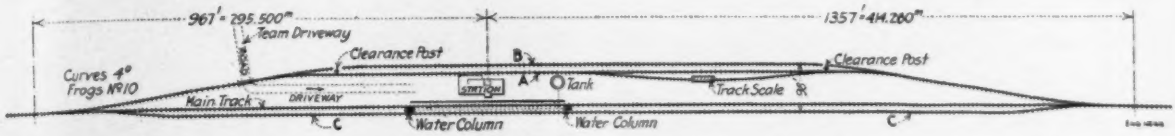
The item of overtime for train crews, together with additional fuel consumed and delay to equipment and freight, is a serious matter with single-track roads. Too much time is consumed by local freight trains at stations, and such a train occupying the main line at stations is frequently the cause of delay to through freight trains which otherwise would not stop, and through freights thus standing do not increase net earnings. The restarting of a train costs money and time, and when a train once stops, all the men have to get ready before it starts again; some crews are quick, while others are slow. The only way to get trains over the road is to keep them moving; main lines are built to run on, and (as far as practicable) should be used for no other purpose.

The accompanying plan represents the layout for local stations as adopted by the National Railways of Mexico, with the above object in view. It is designed with two main features: (1) to keep the main track clear of local freight trains while doing their work, in order to avoid delays to other trains; (2) to furnish a track to be used for local cars only, in order that they will be disturbed as little as possible and avoid interference with the work of shippers or consignees in loading or unloading these cars. Other features are arranged to conform with these two requirements.

Track *A* is the house track; *B* is the team track, and *C* is the passing track. The station has a combination freight and passenger building. At one end is the freight warehouse, with platform on two sides. The platforms are level with the floor of cars standing on the house track *A*; the height of floor of warehouse is just enough higher than edge of platform to give drainage. At the other end is the passenger waiting room, with the station agent and telegraph office between this room and the freight room.

For water stations, the tank is placed as shown, so that engines on track *A* can take water direct from the tank; water columns or engine standpipes are placed between the main track and the passing track *C*; and engines can take water from either track. These water columns are 50 meters (164.04 ft.) in each direction from the telegraph office. Passenger trains can take water while discharging and taking on passengers, express and mail. The scale track is put in only when needed. The freight warehouse is located at the end of station next to direction of business.

Track *A* is built in all cases; track *B*, where there are two freight trains daily in each direction, and track *C* where there are five freight trains daily in each direction. All cars left at station are placed on track *B*, leaving tracks *A* and *B* clear. The length of tracks *A* and *C* will be fixed to suit the traffic. The total length of layout as shown is 700 m. (2369 ft.) between main-line switches, but this is varied by the engineer according to the requirements of each station.



Standard Track Layout for Stations on Single-Track Lines, National Railways of Mexico

Local freight trains are required to head through track *A*, and not use the main track between the main-line switches, unless meeting another local freight. The train spots the local cars at warehouse; the conductor and swing brakeman handle local freight, while the head brakeman with the engine sets out and picks up cars to be left or taken. Generally both parties will finish about the same time, without having blocked the main line, except in entering and leaving the station.

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The Standard Asphalt Pavement of Oakland, Calif., consists of a concrete foundation 6 in. deep, having a 1½-in. asphalt wearing surface laid on a 2-in. binder course of asphaltic concrete. This pavement will sustain the heaviest loads, even bridging over soft spots in the ground, can be torn up for pipes and replaced without damage, and its surface can be restored where worn at a minimum expense for patching. The only objection to this pavement is its slipperyness during a fog or light rain, but this difficulty has been largely eliminated throughout the hand-swept district by placing dry sand in suitable receptacles, to be applied by the street sweepers as needed.—Recent Report of the Commissioner of Public Works.

Investigation of a Break in a 36-in. Force Main, Toronto—Early last March a 36-in. force main connected with the water-works of Toronto, Ont., burst at Devonshire Place, near Bloor St. Apparently little damage was done except to the pipe and the street. We have received from R. C. Harris, Commissioner of Works of Toronto, the following summary of results of investigation of the break:

Our investigations were carried out under these three main heads: (1) defective material; (2) water hammer, and (3) cooling strains.

Samples of iron from each of the broken pipes were analyzed, and its composition was found to be satisfactory. Bars cut from the broken pipes, and tested, gave good results. It would, therefore, appear that the breaks were not due to defective material.

Pressure-recording gages were placed at intervals along the mains, and vibration caused by the electric pumps was shown, but no abnormal pressure was registered, such as might cause the fracture of the pipe. Water hammer might have caused an excessive pressure, which would be transferred along the pipe so rapidly as not to be registered upon the gage, but since both of the breaks occurred during peak load intervals, and also as reliefs occur at two cross-connections, it is improbable that the breaks were caused by water hammer.

There remains the possibility that the breaks were due to cooling strain, and this assumption is strengthened by the fact that both breaks occurred in cold weather, and where the ground is somewhat easily penetrated by frost.

Street Cleaning Methods and Costs at Washington, D. C.

By J. W. Paxton*

SYNOPSIS—In a paper† read before the Sanitary Engineering Section of the American Public Health Association at its Colorado Springs meeting, September, 1913, Mr. Paxton described how an efficient municipal day-labor organization had greatly reduced the cost of street cleaning as formerly done by contract in the city of Washington. Since then, he has received many inquiries as to the exact methods employed to attain these results. In this article are explained the cost-keeping methods for fieldwork, shopwork and stables. Many blank forms and cards are not reproduced, as these would probably vary according to the taste and experience of those who would be likely to make use of them, and because many changes in detail have been made since the system was established and many more are likely to be made before it is perfected. It should be remembered, too, as Mr. Paxton says, that the Washington system as a whole will probably fit no other street-cleaning department; the principles only are important.

One of the first attempts of the new municipal street-cleaning organization, under the Engineer Department, was to establish a cost-keeping system. As not much time was available for preliminary study, a rough system was started and enlarged upon from time to time. This period of development at an end, the other stage, that of elimination, began.

As part of the preliminary study, reports and data from other cities were examined to see what had been done in street cleaning and cost keeping, but no system was found applicable to local conditions. Many valuable data were obtained, however, from the recent publications of well known cost-keeping and scientific-management experts.

The main appropriation of the Street Cleaning Division is for Dust Prevention, Cleaning and Snow Removal, which gives authority to hire laborers, mechanics, etc., but excludes foremen, clerks and superintendents, a separate appropriation, entitled Annual Salaries, being provided for these officials. The last appropriation, under the contract system, paid for inspection and superintendence, and except for minor changes was the same as the present fund.

Comparison of Day-Labor and Contract Costs—Neglecting for the present the items of interest and depreciation, which are thought to be high in contract work and, as will be shown later, are low or nonexistant when the work is done directly by the municipality, the contract price (per 1000 sq.yd.) was composed of the contractor's expenses, the salaries of his supervisory force and his profit. The cost to the city was this price added to the expense of city supervision (inspection, measurement of work done and accounting), or:

(1) Cost to City = Contract price + City Supervision.

With municipal operation, charges corresponding to the contractor's direct expenses and his supervisory or overhead force must be incurred, but no profit need be figured, nor a second supervisory force maintained. Therefore, for municipal operation:

(2) Cost to City = Direct Expenses + Overhead Charges.

If we now suppose that an equal amount be expended under both systems, we have

(3) Contract Price + City Supervision = Direct Expenses + Overhead Charges.

Conditions in Washngton, however, make this overhead charge under municipal operations equal to the city supervision expenses under contract. Canceling, then, these similar items, we have

(4) Contract Price = Direct Expenses.

Contract price, therefore, compared with the direct charges for labor, stable expense, supplies and repairs under municipal operation, gives the saving or additional cost to this city of the day-labor over the contract method of street cleaning.

Object of Cost-Keeping Methods—The object of the cost-keeping system being partly to obtain this comparison, the regular monthly cost sheets of the department include only the direct charges mentioned above. The main advantage of excluding all overhead expenses from these sheets is, however, the ease of comparison between similar gangs or classes of work as well as individual items Overhead expense is added annually as a direct or *pro rata* charge, giving a second set of unit costs which can be used in comparison with unit costs in other cities where this item is included.

Depreciation and interest on investment, as charges against appropriations, are nonexistant. Extraordinary expenditures, such as the remodeling or the purchase of a stable, are provided for by special appropriations. Live stock is secured mainly from other departments, principally the fire and police. Transfers between departments of live stock and other equipment are made without charge. On the General Equipment Account, these transfers are recorded at the full purchase price, but no financial transaction is made. If any equipment or live stock is sold, the proceeds are returned to the United States Treasury and not credited to the appropriation available for current work. Very few sales of equipment take place for this reason; extensive repairs are made, practically offsetting all depreciation.

To admit of comparison, however, with contract costs or unit costs in other cities where it is desired to consider depreciation and interest, a theoretical charge at 5% of the total investment for interest and 1% of this total for live-stock depreciation is made; 1% of the total investment being about 4% of the value of the live stock, giving a third set of unit costs.

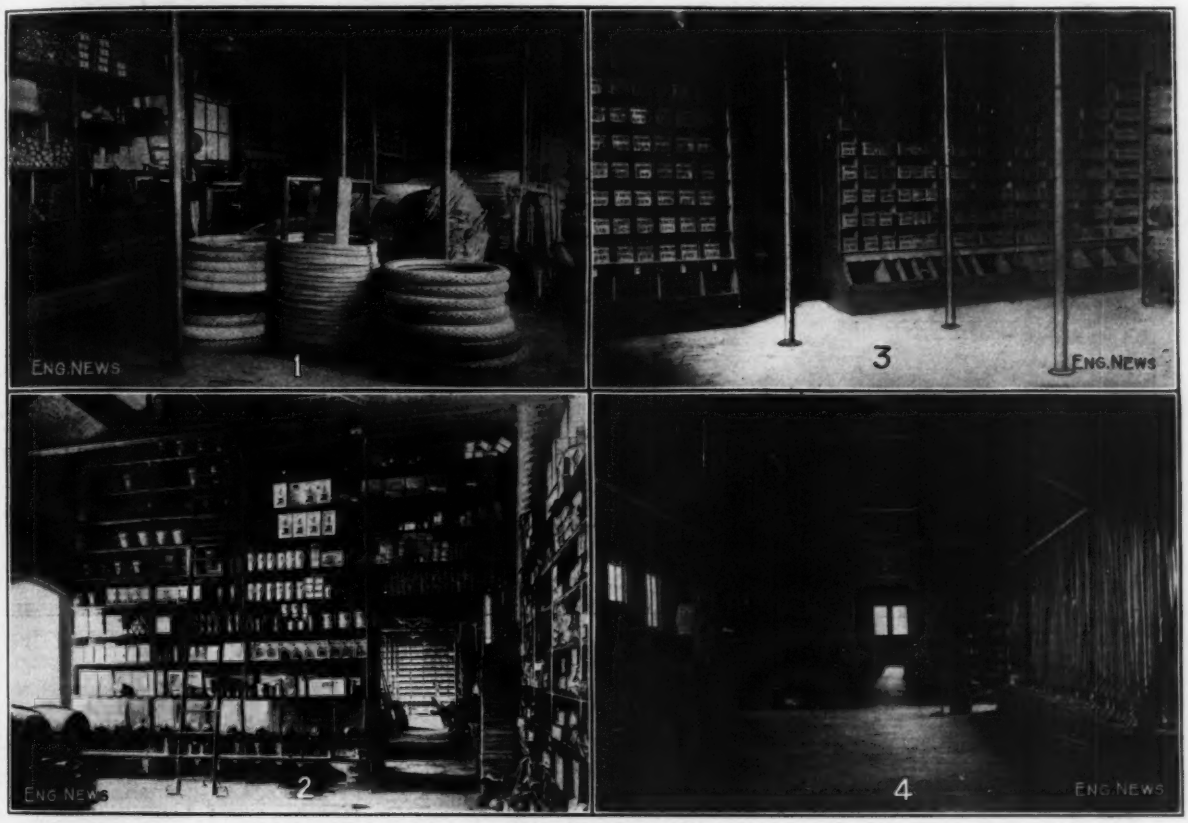
As it is desirable for the cost keeping to check with the accounting, and it is necessary to conform to certain requirements of the auditor, purchasing and disbursing officers, which originated before this cost-keeping system

*Superintendent of Street Cleaning, Washington, D. C.
†Abstracted in "Engineering News," Oct. 2, 1913, p. 681.

was attempted, it is more complicated than a simple division of expenditures to obtain unit costs would be.

Expenditure Chart—Practically the first step was the development of a skeleton diagram showing from what appropriation and under what heads money was expended. The Expenditure Chart (Fig. 1) shows this diagram in its present state and gives the headings under which money is acquired and expended, and how these expenditures finally are included into the three sets of costs, which, when divided by quantities of work done, give the unit cost.

While a portion of the Annual Salaries and Contingent and Miscellaneous are joined up with the Streets appropriation, they reappear only as a Miscellaneous, and the line of this entry joins to Overhead and only enters the cleaning costs, such as Hand Patrol, Alley, etc., in the second set. Thus the first set of costs deals only with the Street appropriation.



Views in Storeroom, Municipal Street Cleaning Department, Washington, D. C.

[(1) View of general storeroom; (2) oil and paint room; (3) bolt rack in general storeroom; (4) lumber, iron and bulk storeroom.]

Purchasing and Stores

All purchases must be made through the Purchasing Officer of the District of Columbia. The different departments notify him of their needs through requisitions, and he attends to the details of the purchase.

Supplies have been divided into two general classes, those purchased as needed on the open market, and certain standard articles contracted for annually, this latter class covering practically all articles regularly used.

Requisition Blanks—Under the cost system, material needed at the storeroom is requisitioned for on two forms, which are merely statements carrying a contract requisition number, the amount, article, item number, unit price, cost, contractor, directions for delivery, purpose; each requisition has an order number, is dated and signed by the foreman and approved by the Superintendent. These forms are purely local and are sent to the general street-cleaning office in duplicate, where, after approval by the Superintendent, the requisitions on the Purchasing Officer are made out. The form for non-contract purchases is printed on green paper, this distinction being advantageous as bids must be obtained, and considerably more time elapses between order and delivery, than is necessary with contract material.

Upon receipt of the official order number from the Purchasing Officer, the local requisitions are given the same number, the duplicate is returned to the issuing storeroom, and the original is filed.

Material Received Slips—When material is received at the storeroom, a statement, giving order number, amount, unit price, date received and account charged to, is sent to the main office. This form is compared with the original requisition on file, for check on the delivery, and no voucher is approved until the requisition is satisfied.

Inventory Cards—Previous to July 1, 1911, stores were carried only for the hand patrol work, and repairs were made only on the few wagons used in that service. Consequently, for the new work, the storeroom and the

storeroom-accounting system became entirely inadequate. The first work in establishing the cost system was, therefore, in the storeroom. The floor space and shelving were more than doubled, a complete inventory was taken, the results being recorded on cards 7¼x9¼ in., designed to fit a filing drawer 9½ in. wide. One such card is made out for each kind of a supply in the storeroom, contract material being on yellow cards while noncontract and manufactured material is recorded on salmon-colored cards.

Requisitions are made up from the information given on the Stores Cards, and are recorded as to date and quantity under the heading "Material Ordered," the Purchasing Officer's order number being filled in upon the return of the duplicate requisition from the general office. Upon receipt of material purchased, the order number and quantity are entered opposite the proper date in the Received column, and the On Hand column increased by the amount received.

ORDER SLIPS—Issues from the storeroom are made on a Storeroom Order Slip, showing to what the articles listed should be charged. This slip is also used for recording credits, the In column being for this purpose. After issuing or receiving supplies on the order slip, the articles listed are entered in the Issued or Received column of the Stores Card, and the amounts are deducted or added to the quantity on hand.

STORE SYSTEM—This Stores Card ledger consists of about 2000 cards and about half the time of one clerk is required to post entries, make out requisitions, etc. The value of stock averages about $20,000.

At first, inventories were taken every six months; but the error found was so small that, at present, material on hand is only counted when a new supply is ordered.

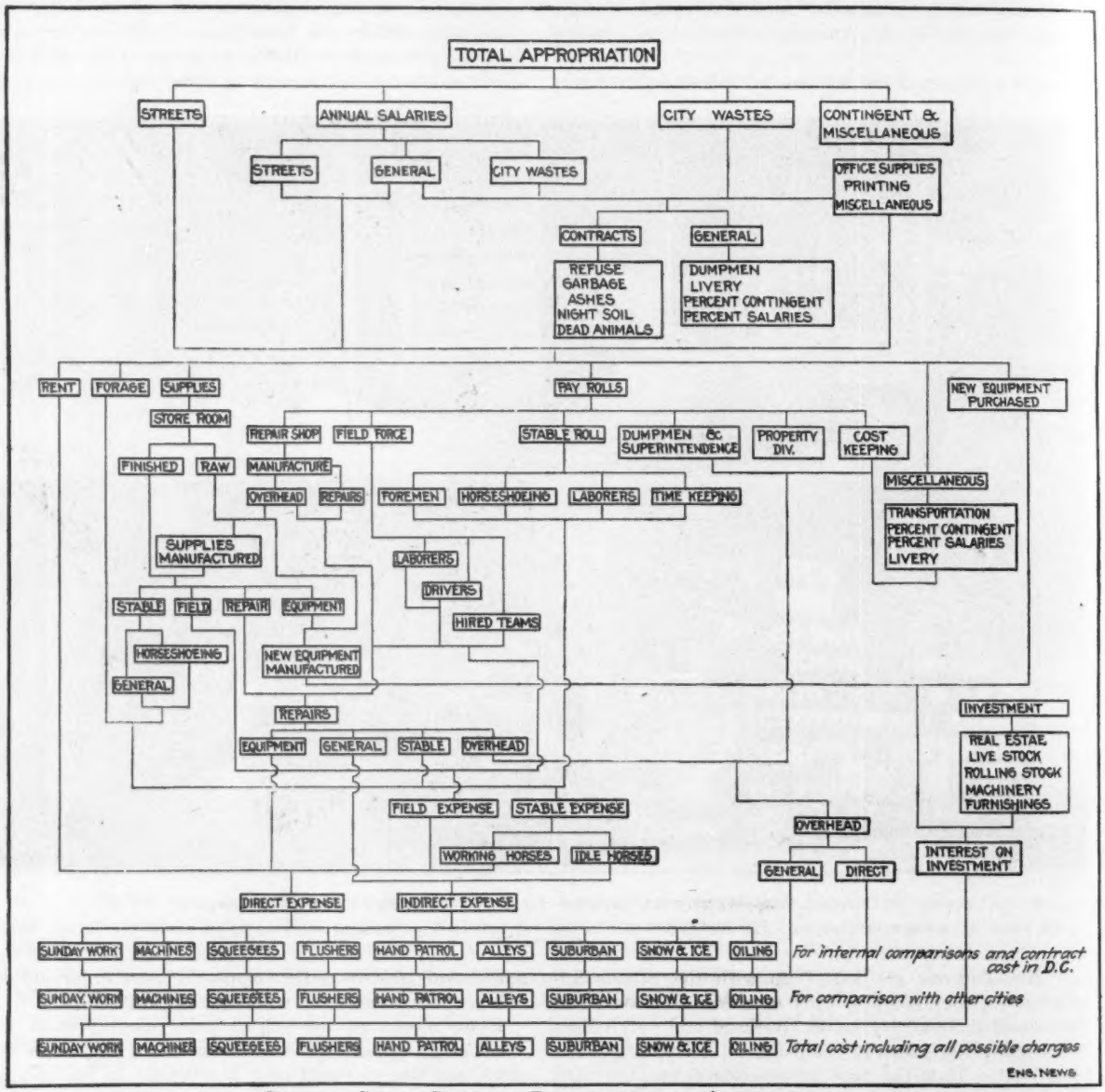


FIG. 1. CHART SHOWING DISTRIBUTION OF APPROPRIATION

(The main heads under which expenditures are made; and items under such expenditures as are regathered in obtaining the various costs.)

With each requisition is forwarded an account showing for each article the amount actually on hand and the amount called for on its Stores Card. This record is of value, not only as a check, but particularly as a guide to the Superintendent in going over the requisitions submitted for his approval.

Among the advantages of some such a stores system are a perpetual inventory of stock on hand, with all articles located, priced, and automatically replenished by maximum limits, which prevents overstocking, and by minimum limits, which prevents running short. Stock is issued only on written order, and all losses eliminated.

Time-Keeping

The appropriations for street cleaning divide the employees into two classes, those paid a yearly salary, the titles and amounts of which are specifically fixed; and those paid per diem.

The duties of the annual employees, which include all the foremen, clerks and higher officials, are not subject to sudden or frequent change, and so far as the cost-keeping is concerned, their time is added yearly as an overhead charge.

Semi-Monthly Time Reports—The time of all per diem employees is reported on the semi-monthly Time Report, consisting of a permanently bound page (*a*), printed and ruled with a column for name, rate of pay, and columns for each day, numbered above from 1 to 7 inclusive, and below from 16 to 22 inclusive, like the left-hand main sheet (*c*); a perforated transparent sheet (*b*), with heading, name and rate columns as on the left-hand page (*c*); the double-page main sheet (*c*), which is bound on a perforated stub; and a page (*d*), printed and ruled as the right-hand main page (*c*), which is a continuation of the left-hand side with the columns for days numbered to 15 and 23 to 31, and there are three extra columns for total hours and days and amount of pay due. Between (*a*) and (*b*) a double-faced carbon sheet is bound, duplicating any mark on the left page of (*c*) on both (*a*) and (*b*). For duplicating on (*d*), characters written on the right-hand page of (*c*), a single-faced carbon is bound between.

On the 13th and 28th of each month, the perforated, transparent sheet (*b*) is torn out and sent to the office, where it is used in entering names and rates on the payrolls, which are then forwarded to the Disbursing officer who transfers this information to the pay envelopes. At the end of the semi-monthly period, the main sheet (two facing pages) (*c*) is separated from its perforated stub. The removal of the carbon sheets leaves the foreman sheets (*a*) and (*b*), which are exact copies of each half of (*c*).

Upon receipt of the main sheet (*c*) in the office, the hours are added, reduced to working days of 8 hr. each, and the amounts due determined. These amounts are then entered on the payroll; and the timebook sheets (*c*), the original record, are bound and filed as the permanent office record. As indicated above, the foreman is also enabled to retain a carbon copy of the original record. This method of time-keeping, as compared with the old method, has eliminated several duplications with the consequent probability of mistakes. Disputes between foremen and office are avoided; clerical work in the field and office is saved and it is possible to pay off one day earlier.

Shop Methods and Accounts

The shops of the Street Cleaning Division comprise a wood-working shop, blacksmithy, paint shop, tin shop, harness and leather shop, broom-making shop, and a general repair shop. Modern power-driven tools, such as an engine lathe, boring machines, power hammer, band saw and planer have been installed, and all repair work is done at the department's shops. In addition, carts, wagons, etc., are built, and such supplies as hand- and machine-brooms, pan scrapers, waste-paper cans, etc., are manufactured.

The greater part of the repair work is on the rolling stock, which is numbered consecutively, carts being 1 to 50, wagons 50 to 75, etc. As the same equipment is always sent out to each gang, and the repairs to each piece of apparatus are recorded on separate cards, these numbers also serve the purpose of job numbers.

Jobs other than repairs to rolling stock are given a key letter and numbered consecutively; all jobs which, when finished, are turned in to the storeroom, have the letter "A" followed by a number, and ordinary jobs have "B," with a number.

Work Orders—The storeroom Order Slip, previously described, when filled out by the shop foreman, is also used as a work order. Each shop is provided with a small rack of four compartments for holding duplicates of these work orders, the first compartment for a job under way, the second for that to be next taken up, the third for future jobs, and the fourth for finished work. The original work orders are filed in a similar manner in the storeroom which is connected to the shop office.

Shop Methods—When a job is finished, the workman removes the slip from the first compartment of his rack, signs, dates and places it in the compartment for finished work. The slip in the second compartment is then moved to the first, the first of those in the third compartment moved into the second, and work commenced on the new job.

Slips are collected frequently from the Finished Work-boxes and turned into the storekeeper, who immediately rearranges his rack to correspond to those in the shops, calling in any material remaining from the old job and issuing that called for on the new order slip.

If additional material is found necessary as a job progresses, the storekeeper adds it to the slip in his rack. Each day the foreman looks over the active slips of this rack and sees that none but proper material and in proper amount has been issued.

After crediting any material remaining from a job, the original and duplicate order slips are fastened together, the material charged off the Stores Cards, and the slips are then sent to the main office for posting on the cost records.

Paint and Harness Shops—In the case of paint and harness shops, it has been found necessary to vary the normal shop procedure. It is impossible to issue and return leather and paint after each job without driving the system to extremes. Leather and paints are accordingly issued in small quantities, these being charged on an Order Slip as a supply to the shop. When turning in work orders, the amount and kind of paint, or leather,

used is indicated by the workman. In the main office, a perpetual inventory is kept, and checked at the end of each month, by an actual inventory of material on hand in the paint and harness shops.

General conditions are such that a bonus or even piecework system is impossible; but for manufactured articles, a standard has been set and a certain quantity and quality demanded.

TIME SLIPS—The Time Slip records give the time of

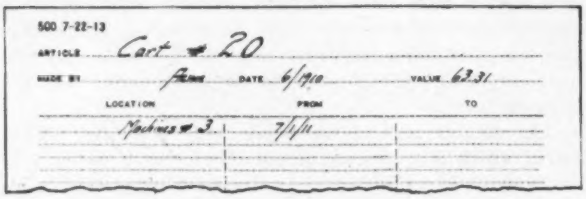


FIG. 2. FRONT FACE OF EQUIPMENT CARD; ACTUAL SIZE, 7¾x4¾ IN.

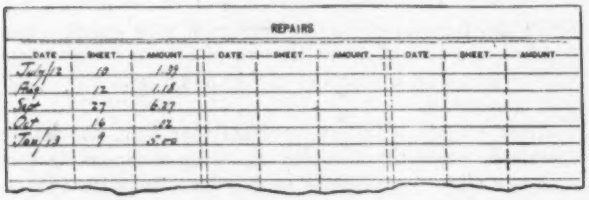


FIG. 3. REVERSE SIDE OF EQUIPMENT CARD

the shop employees. Each man is listed on a separate slip headed with his name, number, and rate of pay per day. The slips are kept by the shop foreman, the job number being placed opposite the time of starting. At the close of the day, the time and amount chargeable to each job is calculated, and the total hours recorded are posted to the man's credit on the Semi-monthly Time Report, previously described.

When the Time Slips are received at the main office, the overhead charge on each job is determined and entered in red ink at the right of the Amount column. This overhead charge is the expense of per diem foremen, storekeepers, timekeepers, etc., at the repair shop and is charged as a percentage of the direct labor cost.

REPAIRS AND MANUFACTURES—As the work of the shops can be divided into two general classes—Repairs and Manufactures—two corresponding office records are compiled. The monthly Repair Sheet, with column headings, material, date, time, total charge to, is used for all repair work whether on rolling stock or "B" jobs; and the Manufactures Sheet, with column headings, date, material used, time, remarks, is used for new equipment or new supplies—all "A" jobs.

The Repair Sheets are made up from the Storeroom Order Slips and the Time Slips. For convenience, the Repair Sheets are grouped as far as possible, all cart repairs being placed on one sheet or set of sheets, wagon repairs on a second set, "B" jobs on a third, etc.

EQUIPMENT RECORDS—Repairs charged on these sheets are transferred to Equipment Cards (Fig. 2), one such card being made out for every individual piece of apparatus owned by the department. The face of these cards record the manufacturer, date and value, as well as its present location, thus forming a convenient equipment account. The reverse side contains a record of the cost of repairs, the Repair Sheet numbers, locating the details of each job for reference. This record of repairs is valuable in comparing the relative efficiency of similar kinds of apparatus.

RECORD OF MANUFACTURES—The Manufactures Sheet is made up similar to the Repair Sheet, the quantity manufactured being credited on Storeroom Order Slips. At the end of each month, these sheets are totaled, incomplete jobs are transferred to the new sheets, and in the case of brooms or other supplies made up in quantities, an average cost is obtained for the month. This is again divided into the average unit cost of each component of the manufactured article, and the information is recorded on the Manufactures Index cards, 5x8 in., giving a comparative unit cost record, showing increases or reductions from previous months.

MATERIALS RECORD—The Material Sheet gives a record of finished supplies received or returned by foremen, stable bosses, etc., the information being obtained from Storeroom Order Slips. A check on the Material Sheet is obtained from the Foreman's Inventory, which is a printed list of all ordinary tools and supplies with column headings to be filled in, on hand, received, sent to storeroom, lost or stolen, remarks. The material on hand in the toolhouses or lockers is also given.

The Supply Summary, 5x8-in. card, collects and condenses the information of the Material Sheet and Fore-

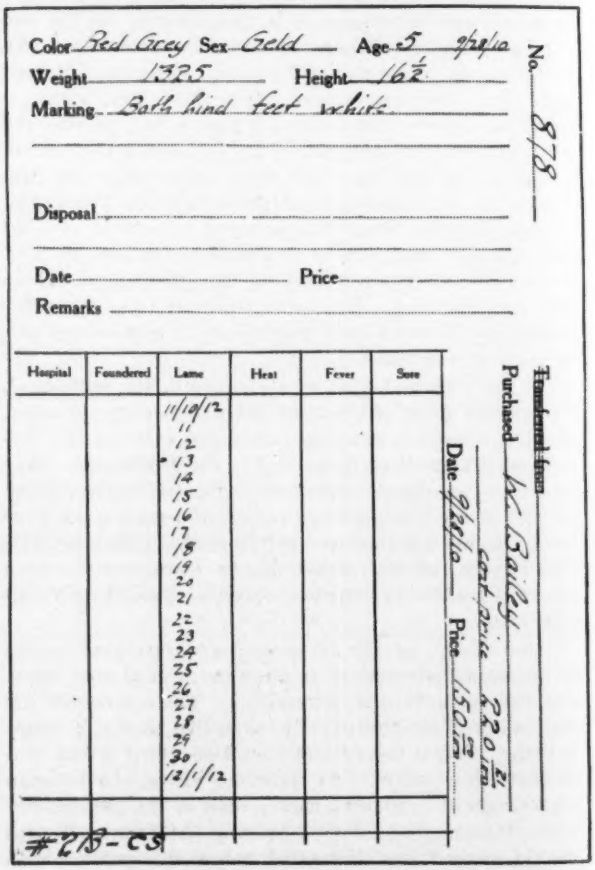


FIG. 4. HORSE IDENTIFICATION CARD; ACTUAL SIZE, 6x4 IN.

man's Inventory in an account which shows immediately any abnormal issues to the foremen or change in the stock carried in the toolhouses or lockers. It also gives a comparative record of supplies issued to or carried by different foremen.

Stables

Horses are obtained by purchase or through transfers from other departments. Every horse is given a description and a number by the district veterinarian. Upon entering the street-cleaning service, this information is recorded on a blue card (Fig. 4), 4x6 in. A disability record is posted from the daily reports of the stable foremen, which shows the assignments of the various horses and is useful in deciding when horses are not rendering efficient service. Upon condemnation, the data and method of final disposition are also entered.

A distribution of the number of horses for each division of the work, under normal conditions, is authorized by the Superintendent. This is entered on the same sheet as the Stable Profile, each time a change is made, in the form of a table, giving also an equipment and labor distribution.

Stable Profiles—The Stable Profiles (Fig. 5) show graphically, on standard profile paper, information obtained from daily reports of the stable foremen, such as the number of horses in the stables, sick, convalescent, available for work, and working. The line of normal distribution given in the tables is also plotted on the same scale. Three separate profiles are kept, one for each stable, and a combination one for the entire division.

Distribution of Stable Costs—For cost-keeping purposes, a monthly Horse Distribution Sheet is arranged from the normal distribution tables which accompany the Stable Profiles, and the daily Horse Distribution Report. If, on account of bad weather, Sundays, lack of drivers, etc., the regular quota of horses has not been worked, their expenses are still charged, as maintenance goes on just the same. In addition, any extra horses which have been used by any division of the work are charged directly. The total expense of the remaining extra horses is divided *pro rata* monthly. The monthly total of horse-days is divided into the total costs for forage, horse shoeing, etc., to obtain the cost per horse per day.

Supplies, other than forage, are issued on the regular Storeroom Order Slip, signed by the stable foreman. Forage is requisitioned for monthly on the contract requisition. Theoretically, this forage passes through the storeroom as though an ordinary supply. No rations are fixed, but each foreman is allowed to use his own judgment as to the needs of his stock unless the cost records and the condition of the animals indicate the advisability of a change. Comparisons between the two stables are made each month, and each foreman is furnished with the costs in his stable.

Forage Records—Forage is drawn out but once each day (there being less possibility of error with the fewer drafts) and later subdivided for each meal. A record of the quantity used is forwarded daily to the main office on Forage Slips, and entered on the Forage Account, which is a perpetual inventory. Forage received at the stable is weighed, and the result sent to the main office with an inventory of the amount on hand, which is compared with the Forage Account, corrections made, and the amount received added. This corrects a small error in weighing and any losses. The foreman is always notified of this error, and an investigation is made if the amount is too great.

Fig. 5. Stable Profile

(Top curve shows total horses in department. Second shows number fit for work. Third shows second less those the stable boss considers in need of a rest. Fourth shows number working. Fifth shows number hired. Dotted line is line of full working force. Bottom curve shows efficiency of stable or percentage of horses fit for work to the total number.

At the end of each month, this account is balanced and the cost of feeding determined. This information is transferred to the Forage Sheet, which gives a comparative statement of forage on hand, ordered and fed; the cost of feeding and the cost per horse per day for a 6-months' period.

Cost-Data Sheets

In compiling the data sent to the main office, Stable Expense is taken up first. The cost of the different gangs is materially affected by this expense. It is entirely independent of the efforts of the gang foreman, and unlike payrolls, continues whether work is done or not.

Stable-Expense Sheets—The Stable Expense Sheet gives the summation of data from the stable, storeroom and repair shop, reduced first to actual cost, per horse per day; and, second, to cost per working horse per day. The second is the first plus a *pro rata* charge for idle horses.

The actual cost per horse per day for forage, labor, shoeing, stable supplies and stable repairs is found by dividing the total costs of these items, obtained from the

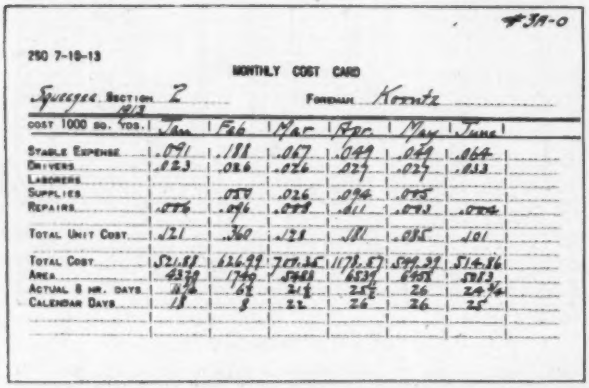
Forage Account, the semimonthly Time Report, the Material Sheets and the Repair Sheets, by the total number of horse-days obtained from the Horse Distribution Sheet.

The cost of feeding idle stock must, of course, be borne by each gang in proportion to the number of horses charged to them. This necessitates a new figure for a cost per working horse per day. This is found by adding to the actual cost per horse per day the result of dividing the total idle-horse expense by the number of horse-days charged against all divisions of work as given on Horse Distribution Sheet.

The total cost of forage, labor, shoeing, etc., may be found either by multiplying the actual cost "per horse per day" by the total number of horse-days or by multiplying the cost "per working horse per day" by the number of working days.

Section Cost Sheets—On a printed Section Cost Sheet, all items of the expense previously obtained are assembled and arranged for each gang to indicate the total and unit costs of cleaning for each division of the work, as well as the unit cost of each item.

To obtain the item for Forage on this sheet, the number of horses charged to the gang on the Horse Distribution Sheet is multiplied by the average actual cost per horse per day for forage on the Stable Expense Sheet. In the same way, the items of Stable Labor, Horseshoeing, Stable Supplies, Stable Repairs, and those bracketed as Extra Horses, are obtained from the Horse Distribution Sheet and the Stable Expense Sheet.



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MONTHLY COST CARD

Foreman Koontz

Cost 1000 sq. yds.	Jan.	Feb.	Mar.	Apr.	May	June
Stable Expense	.091	.181	.067	.049	.049	.064
Drivers	.023	.026	.026	.027	.027	.033
Laborers						
Supplies		.057	.026	.096	.095	
Repairs	.076	.096	.099	.011	.093	.0006
Total Unit Cost	.121	.360	.218	.181	.085	.101
Total Cost	$21.81	$26.99	$37.36	$171.57	$99.39	$14.86
Area	4330	1740	5481	6534	6481	5813
Actual 8 hr. days	8	6½	21	25½	26	24¾
Calendar Days	13	8	22	26	26	25

Fig. 6. Monthly Cost Card Sent Each Foreman Every Month, Giving Costs for His Gang; Actual Size, 7¼x4¾ In.

The items for drivers, laborers and hired teams are obtained direct from the Semimonthly Time Report. The item for section supplies is obtained from the Material Sheets.

The items for section repairs and general repairs are obtained from the Repair Sheets. All rolling stock is permanently numbered and each gang assigned sufficient equipment for normal conditions. Repairs to this equipment are charged direct. Sufficient extra rolling stock is carried to replace any being repaired or to cover extraordinary demands. Repairs to such equipment are divided *pro rata* on the regular quota and charged as general.

Work Summary Sheet—From a Work Summary Sheet, the actual number of 8-hr. days worked, the calendar days worked and the area cleaned is obtained. Each item making up the total cost for the month is divided by the area cleaned, giving the detailed costs per thousand square yards, from which comparisons are made between the costs of different methods of work, one gang's work with another similarly engaged, and the same gang in previous months.

As this office study resulted in increased efficiency, an effort was made to secure the foremen's interest and co-operation by sending them each month on a Monthly Cost Card (Fig. 6), the principal features of the Section Cost Sheet, together with a letter indicating conclusions reached by office study, if important.

Automobile Cost Sheets—The Automobile Sheet is a comparative record of automobile data. The item of supplies issued is from the Supply Sheets, the repairs from the Repair Sheets and the time from the Repair Shop Time Slips. Odometer readings are taken when tires are changed, and also at the end of each month, from which the mileage figures are computed.

Summary Sheets—A Summary Sheet assembles in convenient form, the information for all classes of work from the Section Cost Sheets and represents the total expenditures from the appropriation for street-cleaning work alone, the unit costs representing the first of the three totals referred to in the introduction.

Expenditures from the other appropriations are now brought in the account and the second and third set of unit costs previously referred to obtained. Direct charges are made wherever possible and other items divided *pro rata* according to their relation to the main charges. An annual Cost Sheet represents this account, the notes explaining the transactions. The figures for street cleaning have been obtained from the cost keeping, while those of the other appropriations have been taken from the accounting.

The error of the cost keeping, as shown on this sheet, amounts to about 1 in 1000. This account shows the excess of stock and equipment over that of the previous balance, the error, when the actual value of stock and equipment taken care of by the cost keeping is considered, amounts to only about 1 in 1900. This error is, however, positive and no doubt due to a considerable extent to the use of a slide-rule in working out cost data.

Working Chart—The Working Chart (Fig. 7) subdivides the Annual Cost Sheet into the cost-keeping records, which go into its make-up, forming a skeleton, not of expenditures, but of the cost-keeping system. This is emphasized in the original chart by printing secondary records in black, primary in red, office in brown, and those for which no special form has been provided—informal reports—in green.

The idea of this chart is purely a guide to the office, a record showing how the reports are being used and who is responsible for the making up of the different records. This feature of having, under each record, the name of the party responsible for its accuracy and upkeep has proved almost invaluable. Any question as to responsibility is immediately settled by referring to the chart and any change in force shows exactly what records must be shifted to new men.

Conclusions

That increased efficiency has resulted from the establishment of a cost system is plainly shown by the de-

creased unit costs in every class of work. No large outlay for equipment or labor was required and no changes in personnel were made in the development and application of the cost keeping.

At the present time, all the office force necessary to keep up the cost-keeping system is done by five men, the entire payroll amounting to less than $4000 per year. Previously, about $1500 per year was expended in keeping records now included in the cost system, such as statistics of quantities of work done, arrangement of schedules, etc. The printing is now done in the office and the labor employed included in the above figure.

The principal advantages of the cost system may be summarized as follows:

(1) Gives the detailed cost for each gang, for each class of work or for any particular feature thereof, in such form as to admit of direct analysis of any variation from previous costs or comparison between similar details of other work.

(2) In the same way, gives the result of any change in methods of working.

(3) Provides a means of determining the relative efficiency of foremen or laborers, a tangible record for educational purposes, giving in money the effect of any internal change in the make-up of a gang and means of competitive comparison between gangs.

(4) Gives records of intermediate costs, such as stable, repair-shop or office expense, in which the greatest possibility of saving lies, in terms which admit of comparison with other departments or firms, as well as inter-

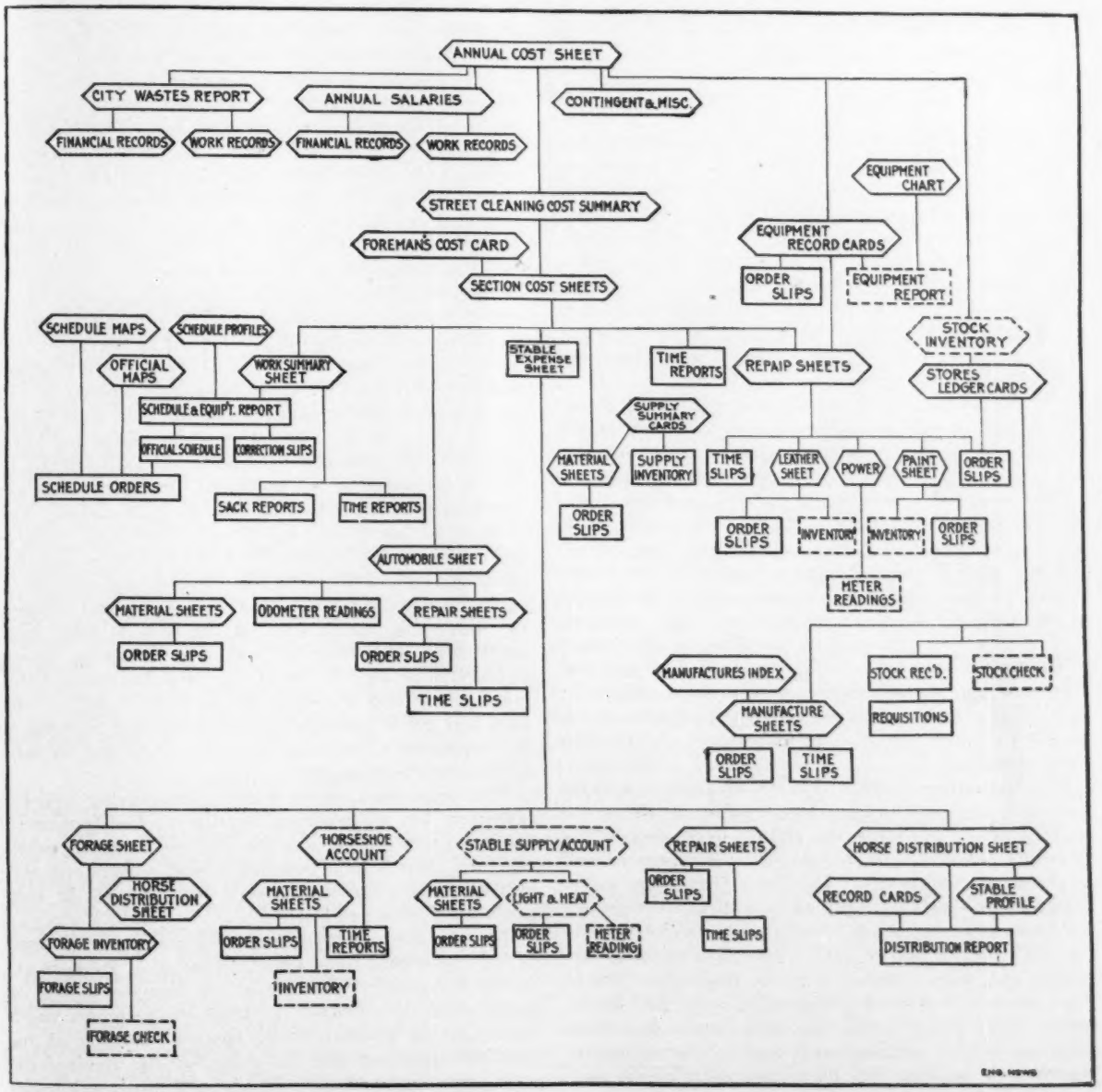

FIG. 7. CHART SHOWING THE DIFFERENT RECORDS OF THE COST-KEEPING SYSTEM AND HOW COMPILED TO MAKE UP THE ANNUAL COST SHEET

(Original records for which a regular form has been issued are shown in a solid rectangle; informal original records are shown in a dotted rectangle; secondary records for which a regular form has been issued are shown in a diamond-shaped figure; while informal secondary records are shown dotted.)

nal comparisons between two units, such as two stables of the same department.

(5) Gives repair costs, which in time, will admit of comparison as to relative efficiency of two similar pieces of apparatus of different manufacture, as well as a check on excessive repairs.

New applications are constantly coming up to keep the system alive. Often some new item will creep into a standard report, be investigated and result in a new train of thought and study, with increased efficiency and renewed interest, not only in the new feature but necessarily in the routine which is required to develop the working figures.

The Wisconsin State Building Code

By Sidney J. Williams*

Previous to 1913, Wisconsin state building regulations consisted of a few isolated statutes on fire escapes, exit doors, elevator shafts and scaffolds; a comprehensive tenement house law, embracing both fire-protection and sanitation, for cities of the first class (i.e., Milwaukee); and a tenement-house law of limited scope for smaller cities. The fire-escape law, which was enforced by the Bureau of Labor (succeeded in 1911 by the Industrial Commission) gave insufficient protection when applied to some types of buildings, while in other cases it was so unreasonably rigorous that it could not be enforced.

In the prevention of industrial accidents, very good results had already been obtained under a statute which, instead of prescribing specific machine guards, etc., simply laid down the broad principle that all places of employment must be made reasonably safe, and empowered the Industrial Commission (subject to court review) to fix specific standards of reasonable safety. These standards or "general orders," being a creature of the Industrial Commission, could of course be altered, interpreted or suspended by the Commission at any time. As a result of this elasticity, and of the Commission's policy of having the actual detailed orders drafted by practical shop men and manufacturers, a great improvement in shop safety and sanitation was brought about without unnecessarily burdening the manufacturers or arousing their opposition.

The legislature of 1913 decided to apply this same method to the subject of building regulations. This was easily done by amending the statute mentioned in the preceding paragraph, to include public buildings as well as places of employment. The latter terms were so defined as to include practically all buildings except private residences; the term "safe" had already been defined to cover life, health and welfare. Specific statutes in fire escapes, etc., were repealed, with the single exception of the tenement-house law for Milwaukee, which had proved satisfactory. The way was then open for the Industrial Commission to formulate, adopt and enforce a comprehensive state building code on a much more elastic basis than is usually possible.

The Commission's broad power along these lines was subject to four limitations, which were really more beneficial than otherwise:

(1) The Commission's jurisdiction does not cover private residences.

(2) The code is confined to the protection of life and health. Ordinarily such protection must be sought by the same means, and with the same results, as the protection of property. There are some regulations, however, such as fire-limit restrictions and the limitation of the size of one-story buildings, which are a necessary precaution against a general conflagration, but are not necessary to the safety of the individual occupants. Such regulations cannot be included in the state code but must be covered by local ordinances.

(3) The code must be "reasonable." This statutory provision simply enforces, by the threat of court review, the policy which a wise commission would pursue in any case. It is the uniform policy of the Wisconsin commission to apply the criterion of reasonableness very strictly, not only to all its general orders, but also to the application of these orders to particular cases. The Industrial Commission will not order any safeguard on a machine or on a building, unless the resulting benefits well justify the expenditure. Under a rigid specific statute this policy would put the Commission in the undignified attitude (to say the least) of winking at a violation of law. Under the Wisconsin statute, as stated above, the Commission can legally follow the obviously businesslike policy of altering, interpreting or suspending its own rules if necessary in order to "make the punishment fit the crime."

(4) A very important practical limitation is that imposed both by the limited funds of the Commission and by its general policy, namely, that the code must be enforced largely by the coöperation of fire chiefs and other local officials. The statute requires all local officials to enforce the orders of the Industrial Commission; but efficient coöperation cannot be obtained with a club. The Commission has tried to insure such coöperation by sending copies of the tentative code to architects and fire chiefs throughout the state, for criticism, and by holding public hearings in several cities; and is prepared to make any reasonable modification in the code to meet local conditions. This may not make the Wisconsin code a technically perfect document; but the Industrial Commission feels that it is wiser to aim at 80 or 90% of the ideal and get it (or most of it) by peaceful methods as far as possible, rather than to ask for 100% and, by hard fighting, get perhaps 50.

This proposition, of the necessity of securing local cooperation, has an important corollary. The framers of the Wisconsin code believe that if the village (or small city) fire chief is to be expected to read, understand and sympathetically enforce the state code, it must be both easily intelligible and brief.

To make the code brief, only those points were covered which, under conditions actually existing or liable to exist in Wisconsin, constitute a real menace to life or health; and the emphasis is placed on the points which constitute the greatest actual menace. Readers of the code will thus find that fire-protection has received the most attention, sanitation the next, and structural design the least.

It is apparent from the foregoing considerations that the Wisconsin state code will not take the place of a local code in any city or village large enough to have fire limits.

*Building Inspector, Industrial Commission of Wisconsin, Madison, Wis.

Such a limitation of the scope of the state code is believed to be desirable. There is much truth in the common contention that differing local conditions require different treatment. Moreover, common sense and psychology agree that the best way to interest a man in anything is to give him something to do. The best way to secure the coöperation of local officials in enforcing a state building code, is to leave to them the task of working out local regulations to supplement the state code. The scope of such local regulations will depend on the size of the municipality; ranging from a simple fire-limit ordinance to an elaborate code which might include, among other things, detailed specifications on structural design and workmanship. In some particulars, e.g., the limitation of nonfireproof construction, the local code might well set a higher standard than was considered feasible for the state code. Even the smallest municipality will be encouraged to require building permits and will be assisted in working out a simple and economical system of building inspection. The Commission considered the advisability of requiring a state building permit, except in cities which require a city permit; but this was given up as being too obnoxious and irritating in localities where considerable missionary work is necessary to overcome the popular prejudice against any building restrictions at all.

The code was drafted by an advisory committee of architects, with the assistance of other architects and representatives of various interests. The Industrial Commission's building inspector, as secretary of the committee, handled the necessary correspondence and investigations, consulted with specialists on various subjects and drafted the various sections for discussion by the committee. Existing codes were consulted and used in varying degrees.

The code was first printed in tentative form and distributed for criticism. The discussions at the public meetings have brought out a number of suggestions; most of these deal with minor matters, and most of them will probably be accepted; none was really vital. No objection has been heard as to the general purpose and essential features of the code.

After all criticisms have been received, they will be considered by the building code committee, which will then make a final report to the Industrial Commission; the code will then be formally adopted by the Commission, probably about Aug. 1, and will become effective thirty days later.

Arrangement and Contents

The arrangement of the code was chosen with the object of making it as easily intelligible as possible. The first four "parts" apply to all classes of buildings; the last four take up the four classes into which all buildings covered by the code are divided, and give the requirements peculiar to each class.

Part I. Scope of the Code—This part briefly defines the application of the code to new buildings, alterations and changes of occupancy. The question of fire escapes and other fire-protection in existing buildings is not covered by the code but will be the subject of other "general orders" to be issued in the near future.

Part II. Definitions and Standards—Here are defined four types of construction—fireproof (wood floors and trim permitted), mill, ordinary (brick walls and wood-joist floors), and frame (including veneer). This part also contains specifications for standard fire escapes, inclosed fireproof stairways or "smokeproof towers," horizontal exits, etc.

Part III. General Requirements—In this part are included the usual limitations of height and area of buildings; minimum sizes of courts; construction, size, ventilation, etc., of toilet rooms; protection of boilers, furnaces, stoves, smokepipes, steam and hot-air pipes; and similar subjects. The most interesting section of this part, however, is one which provides that all buildings must be designed and supervised by competent persons. This provision has been criticized as being of no practical value, since there is no architects license law in Wisconsin, and since the Industrial Commission is hardly in a position to pass on the competency of all architects, engineers and builders in the state. It was felt, however, that a definite stand should be taken against the designing and construction of buildings by irresponsible parties, even though a complete enforcement of this regulation is impossible.

Part IV. Structural Design—This section gives permissible floor loads and unit stresses. Both are fairly conservative.

Part V. Factories, Offices and Mercantile Buildings—This is mainly devoted to the fire-protection of such structures, with an especially complete section on stairway requirements.

Part VI. Theaters and Assembly Halls—Existing theater ordinances offered plenty of material for this.

Part VII School Buildings, Libraries and Museums—Here again the fire escape and stairway requirements were the hardest problem, and are the parts to which most attention is desired.

Part VIII. Apartment Houses, Hotels and Places of Detention—This classification includes practically all buildings, except residences, in which persons sleep at night. The principal requirements are for fire-protection.

In the foregoing discussion, many features of the new Wisconsin code, relating to sanitation, ventilation, lighting, and other subjects, have not been mentioned at all for lack of space. The emphasis has been placed on fire-protection because that is actually the greatest problem which had to be met.

Experience will no doubt indicate the necessity of changes in and additions to the code, and may disprove some of the arguments developed in this article. When changes become necessary, they can be made without any legislative investigation or special machinery, thanks to the elastic basis which is the most important feature of the Wisconsin code.

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A Reinforced-Concrete Pontoon, for a landing stage for ferry service, has recently been put into use in the Harbor of Sydney, Australia. The pontoon is 100 ft. long, 43 ft. wide at one end and 68 ft. at the other, 7 ft. 9 in. deep, with a 32-in. freeboard. The bottom is flat, and the sides and ends are sloped to an angle of 70°. Special attention was given to the design of the reinforcement, with a view to enable the construction to withstand the excessive strains likely to occur should vessels be berthing at each side of the pontoon at the same moment. In the construction of the top and bottom of the pontoon, allowance has been made for a live load of 150 tons, which will be distributed over the center length between the posts. The whole structure is divided into 48 water-tight compartments by solid reinforced-concrete walls. It weighs about 650 tons. A view and a brief description appear in the "Commonwealth Engineer" for June, 1914.

A Box Type of Abutment for Subways at Memphis, Tenn.

By Paul D. Fuqua*

For some subways on grade-separation work, at Memphis, Tenn., a box type of combined abutment, curb pier and sidewalk span was adopted.†

The streets to be carried under the tracks were generally 60 ft. wide and the length of subways between right-of-way lines 100 ft. or over. As it was desired to reduce to a minimum the length of time during which trains would have to be operated over falsework and temporary tracks, it was decided to make the deck of slabs cast in a yard adjacent to the subway, these being set in place on the substructure after they had thoroughly seasoned. By adopting this method, it was possible to cast the slabs in advance and have them ready for use. The heaviest slab weighed about 40 tons and was easily handled by a 100-ton wrecking crane. Fig. 1 shows one of the large parapet slabs being placed in this way.

The city ordinance under which the work was carried out, provided that one line of supports be placed in the middle of the street and two at the curb lines. The designs for the first two subways to be constructed under this ordinance provided independent footings for the bents at the curb lines and for the abutments (which latter were of the counterfort type). With this type of construction (Fig. 1), it was necessary to cast each line of slabs in four sections, two of which covered the space between the curbs while the other two covered the sidewalks.

In the two following subways to be built, a box type of abutment was adopted, which combined in monolithic construction the three former subdivisions of curb bent, counterfort abutment and sidewalk slab. A typical design is shown in Fig. 2, and a section through the center line of one of the curb piers (which were spaced 8 ft. to 9 ft. apart) is shown in Fig. 3. Fig. 4 shows one of the subways under construction, and attention is called to the method of finishing the ends of the box-type abut-

Fig. 1. Concrete Subway with Slab Spans at Memphis, Tenn.

(The wrecking crane is setting a parapet slab on one of the street spans. The sidewalk spans in this case are similar but smaller slabs.)

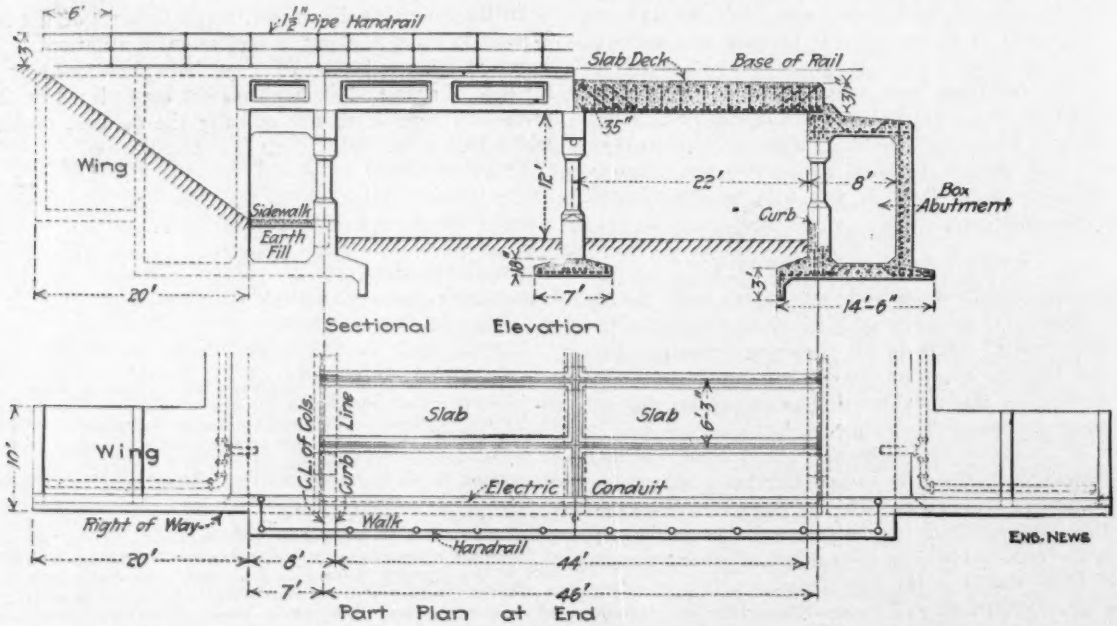


Fig. 2. Typical Design of Subway with Box Abutment (Combining Back Wall, Footings, Curb Bent and Sidewalk Span)

*Assistant Engineer, Morgan Engineering Co., Dayton, Ohio.

†The subways are on a line of railway which extends along Broadway or Railroad Ave. toward the Memphis Bridge. The two first subways with separate abutments and curb bents are at Rayburn Boulevard and Mississippi Boulevard. The two with box abutments are at South Third St. (100 ft. long), and South Main St. (140 ft. long), the length of the latter being due to a Y-track connection to the new station of the Illinois Central R.R.

The right-of-way on Railroad Ave. is 100 ft. wide, and the tracks were elevated in connection with the construction of the new union station, which was opened in 1913. This station is owned by the Memphis Union Station Co., of which W. F. Schulz was Engineer of Construction, and he was also engineer for the Board of Control appointed by the four railways interested to represent them jointly in carrying out the track-elevation work and subway construction adjacent to the station. The box-abutment design described in this article was designed by Mr. Fuqua while acting as Assistant Engineer under Mr. Schulz.—Ed. "Eng. News."

ment. On the right side, the roof slab slopes up, and is paneled, which gives the bridge the appearance of having the slabs extend over the abutment. The falsework at this bridge was provided for four of the nine tracks which are normally operated over it.

In the comparative estimate made for constructing a subway 100 ft. long, and based on local prices for work,

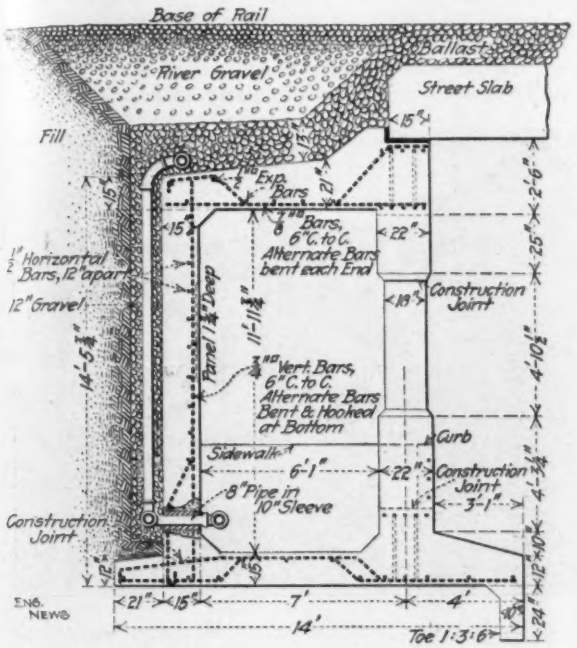


FIG. 3. SECTION OF BOX ABUTMENT, WITH DRAINAGE SYSTEM

the saving in cost by adopting the box design in place of the design which provided independent curb bent, abutment and sidewalk slab, amounted to some $1700. Among the items on which a saving was effected, may be mentioned the following:

1. The volume of excavation required was reduced by allowing the toe of excavation slope to be moved in from a point 7 ft. back from the face of abutment (with independent abutment) to a point 3 ft. back (with box-type abutment).

2. The volume of backfilling required after the abutment was finished was reduced by the amount of the excavation saved, some 6 cu.yd. per lin.ft. of subway.

3. A saving was effected in the cost of waterproofing the tops of the slabs by reducing the width to be waterproofed some 8 ft. over the sidewalks, on each side of the street. The cost of the waterproofing is usually 25c. to 30c. per sq.ft.

4. The cost of construction was reduced by an amount estimated at $1 per cu.yd. of concrete on account of simpler form work, more massive construction, the fact that concrete could be placed and tamped more easily, and that the reinforcing steel could be bent and placed at less cost.

5. The yardage of concrete in the box-type abutment was about 1% less than in the construction which it replaced, although the sections were more liberally proportioned than in the design for the counterfort abutment. The latter provided shallower foundations, a face wall only 8 in. thick under panels, reinforced with only one set of reinforcing bars which were bent in at the counterforts and out in the slabs between them, to take care of both negative and positive bending moments.

6. A further saving was made in building the sidewalk slabs in place by eliminating the cost of setting them with the wrecking crane, which (under traffic) amounts to about $1 per cu.yd. of concrete.

Among other comparative advantages which do not affect cost but which are highly to be desired may be noted the following:

1. A more impervious abutment wall is secured, on account of increased thickness and better tamped concrete. With the main reinforcing bars vertical, the stone in the concrete has much less tendency to "pocket" than when these bars are horizontal.

2. More impervious sidewalk slab construction is secured by building the slab in place, in that open joints at each end of the sidewalk slab, and between slabs at intervals of 6 ft. 3 in., are entirely eliminated.

3. There is better drainage, as indicated by Fig. 3. A pocket of gravel is provided over the sidewalk span, into which the water drains readily from the street spans. This water is carried off by a 6-in. vitrified-tile drain laid with open joints. Down pipes 20 ft. apart are laid in a 12-in. filling of gravel behind the abutment, each with an 8-in. pipe extending through a 10-in. sleeve in the wall, and an 8-in. vitrified drain at the back of the abutment.

4. There is an inherent advantage of monolithic construction over unit construction, in absorbing impact and vibration due to passing trains.

In the work described above, the superstructure was designed for a live-load equivalent to Cooper's E-55 load-

FIG. 4. SUBWAY WITH BOX ABUTMENTS COMPLETED AND READY FOR THE SLABS OF THE STREET SPANS

ing, with an addition of 50% of the live-load to cover impact. The substructure was designed to carry live-load plus dead-load with no allowance for impact. High-carbon deformed reinforcing bars were used. The percentage of reinforcement was arrived at by allowing a unit stress of 17,000 lb. per sq.in. tension in steel and 650 lb. per sq.in. compression in concrete.

The writer was employed on this work for 18 months as assistant engineer and made the design for the box type of abutment described.

The Ohio State Highway Department had already obtained over half a million dollars from automobile license receipts up to June 23 of the present year. The expenses of administration amount to less than $100,000 a year, so that the Highway Department has already received five-sixths of the gross income from this source. Another $100,000 is expected before the end of the year.

Balcony Framing, McBride Theater, Victoria, B. C.

Some interesting balcony-framing features are found in the McBride Theater, recently built in Victoria, B. C., by the Victoria Opera House Company, Ltd. Following the general modern practice, the balcony is supported by a transverse truss, eliminating columns in the clear space of the auditorium below; radial cantilever girders resting on this truss and anchored in the back wall, support the balcony floor-beams. The radial girders are of unusually long overhang—up to 31 ft. at the maximum—and because of the mezzanine foyer below, they are of peculiar shape.

The theater building is 90 ft. wide by 150 ft. long. The small-scale plan in the drawing herewith shows the arrangement of the balcony framing. The balcony-truss columns are set a short distance inside the side walls. The truss is 74 ft. 10 in. long c. to c. of end columns; its effective depth is about 8½ ft. There are seven radial girders of full length to back wall, and two auxiliary radials so located that they could not receive wall anchorage. The back end of each auxiliary radial is supported and anchored by a short loading girder in the plane of the floor-beams, while the middle of the radial is suspended from an 18-in. I-beam set just above the regular floor-beams and concealed under the second step of the balcony.

The roof column just back of the boxes has the balcony fascia girder attached to it, but is stiffened in both directions, transversely by a beam connecting it with the wall column and longitudinally by a 15-in. floor-beam. The fascia girder is a light 16-in. plate-girder.

The Warren-system web of the balcony truss gives room for passing the radial girder between the chords, without interfering with the truss members. It is fastened by shoe and stay-gusset connections to the lower and upper chords. This position of the radial girder brings it considerably below the stepping of the balcony. In consequence, back of the balcony truss, where the mezzanine foyer required increased clearance, the line of the radial girder is offset upward, producing a reversed bend in the outline of the girder. The splices at the angles do not involve any particular complication.

The radial girders weigh about 6½ tons each. They were shipped and erected entire.

The balcony truss, whose makeup will be clear from the drawing, has its end panels sloped up, which gives it a sagging shape. Inclined passage-ways (in place of steps) from the street level to the balcony cross under the balcony truss at the ends at about the level of the bottom chord, and the headroom needed for these pas-

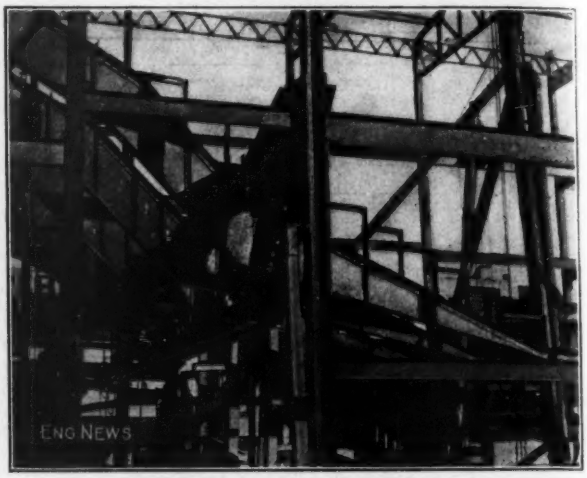


FIG. 2. BALCONY STEELWORK OF MCBRIDE THEATER, VICTORIA, B. C.

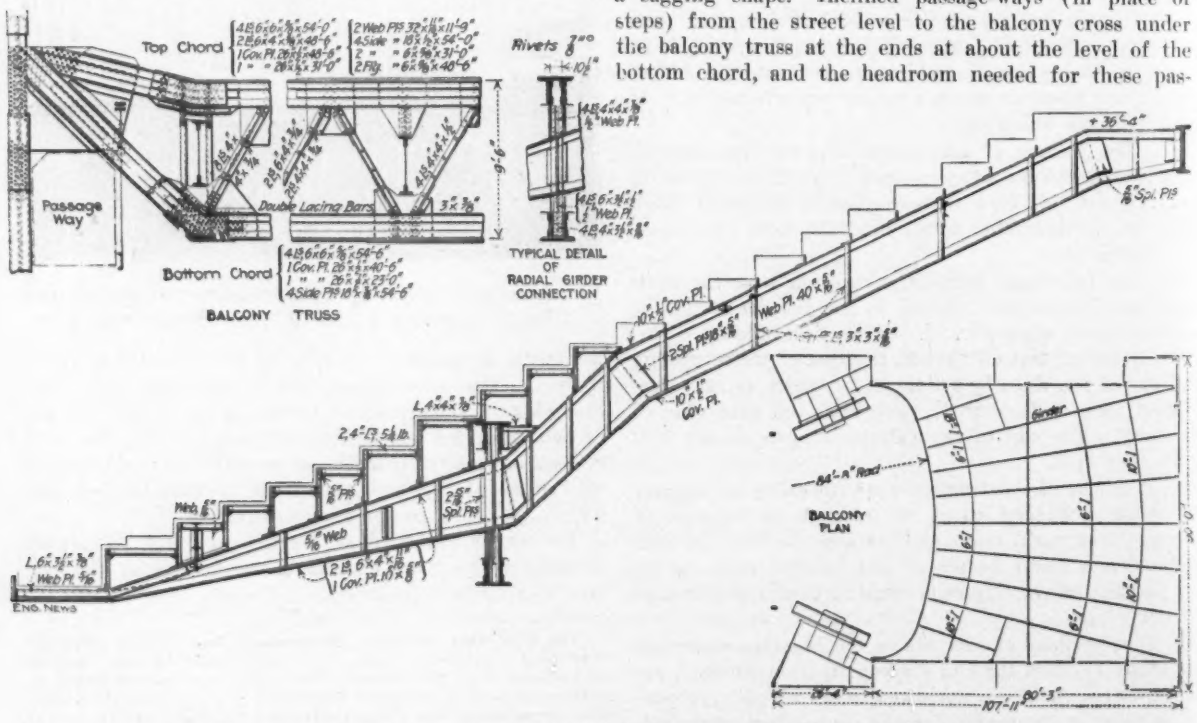


FIG. 1. BALCONY TRUSS AND CANTILEVER GIRDERS OF MCBRIDE THEATER

sage-ways required the truss to be sloped up. Since the balcony floor is a curved surface, the clearance over the truss increases at the sides sufficiently to give ample room for the sloped panel.

The total weight of the balcony truss is 51 tons. The truss was assembled in the shop and all connection holes reamed to match, then knocked down, slipped in separate pieces, and erected in the field.

The roof and floors throughout the building are reinforced-concrete slabs with triangle-mesh reinforcing.

The McBride Theater cost $400,000. It is considered to be one of the finest buildings of its kind on the Pacific Coast. The steel framework has a total weight of 500 tons. The foundations are concrete piers through mud to bedrock, 20 to 50 ft. below sidewalk. They were constructed by sinking open cylinders and filling them with concrete after reaching rock.

Rochfort & Sankey, of Victoria, B. C., were architects for the theater, and H. W. Bittman, of Seattle, Wash., was structural engineer. Pinney & Mc Lellan were the general contractors, while E. E. Davis & Co. erected the steelwork.

Asphalt Paving Repairs in St. Paul, Minn., by Municipal Day Labor*

In 1912 the city of St. Paul, Minn., purchased a municipal asphalt plant at a cost of about $15,000. The plant consists of a Warren Bros. portable asphalt plant, one 8-ton asphalt steam roller, one scarifier, one Lutz surface heater, one fire wagon, one gyratory stone crusher, two portable melting kettles, six 2-cu.yd. steel-lined asphalt wagons, four ¾-cu.yd. concrete spreaders, one set of curb cutter's tools, nine asphalt rakes, testing scales, and the necessary small tools. The accompanying table gives an itemized cost of the plant.

	No.	Rate	Cost
Warren Bros., portable asphalt plant	1	.....	$4850
Steam roller, 8-ton	1	.....	2250
Scarifier	1	.....	365
Lutz surface heater	1	.....	1800
Fire wagon	1	.....	112
Melting kettles	2	$425.00	850
Asphalt wagons, 2 cu.yd	6	171.50	1029
Concrete carts, ¾ cu.yd	4	117.00	468
Koehring concrete mixer, No. 14	1	.....	1950
Tandem steam roller, 8-ton	1	.....	2200
Koehring paver, No. 14	1	.....	1900
Chain belt paver, No. 15	1	.....	1770
Chicago concrete mixer, No. 5	1	.....	481
Tinius-Olson brick tester	1	.....	475

The plant was put into operation Apr. 25, 1912, and during the season of 1912 was worked a total of 92 days. The amount of asphalt pavement turned out during the season was 19,428 sq.yd.; 15,040 sq.yd. of this was cut out work and 4388 sq.yd. burner work. Besides this, 5459 sq.yd. of asphalt pavement were put down for paving contractors in repairing pavements built under a guaranty; of this, 2363 sq.yd. was cut out work and 3095 sq.yd. burner work. The total cost was $6013, which was charged to and collected from the contractors.

All asphalt-paving repairs during the year 1913 were made by this municipal asphalt plant. The plant was put in operation March 30, and during the season worked 178 days. Asphalt paving to the amount of 44,194 sq.yd. was turned out; 43,296 sq.yd. of this was cut out work and 897 burner work. Asphalt repairs for contractors were made to the extent of 16,832 sq.yd., of which 16,039 sq.yd. was cut out work, and 793 sq.yd. was burner work. The total cost was $21,613, which was collected from the company which had guaranteed the pavement.

For the City Ry. Co., 7370 sq.yd. of asphalt pavement were laid, and the cost, $11,031, collected from the company. For other public-service corporations, 1250 sq.yd. of asphalt pavement and 148 sq.yd. of concrete foundation were laid. This work cost $2340, which was collected from the various corporations.

About 246 sq.yd. of asphalt pavement was laid on bridges on which the city maintains the wearing surface; this cost $430, and was charged against the bridge building and repair fund at $1.75 per sq.yd. Small repairs were made for other city departments and charged against those departments at $1 per sq.yd. The repairs to asphalt pavements on which the guaranty period had expired and for which the city paid, amounted to 14,487 sq.yd. of cut out work. This repair work cost the city $18,490, an average of $1 per sq.yd.

The following shows cost and relative data regarding asphalt repairs for the year 1913:

Total area of pavements on which repairs were made in sq.yd	222,327
Area or repairs in square yards	18,733.18
Per cent. of area repaired	8.42
Cost of repairs	$18,921.34
Average cost per square yard of total area	0.085

Cuts in asphalt pavement made by the City Water Department, heating, lighting and telephone companies, sewer contractors and others, were repaired, at a cost of $2340, which was collected from the various companies.

Cost of Operation—The operating crew at the plant consisted of one foreman, one engineman, one tank man, four laborers, and a night watchman. Four teams were employed hauling asphalt from the plant to the work.

The street crew was made up of one foreman, one timekeeper, one roller man, two rakers, two tampers, one smoother and one cement man laying new pavement; and two shovelers, six scrapers and two teams removing and hauling old paving. The total expense was divided as follows:

Operation of plant, labor		$5,889.02
Fuel		1,024.47
Hauling material		1,559.18
Superintendence, livery, watchman, etc		3,164.21
Repairs and supplies		1,658.05
Material		26,876.59
Street crew labor		8,206.66
Hauling material to street		5,068.40
Engineer and watchman		1,391.65
Tools, repairs, etc		790.05
Total		$55,628.28
Total labor	$25,175.66	
Total material	30,452.62	
		55,628.28
Charged to outside parties	$34,194.23	
Charged to bridges	430.49	
Material on hand	2,512.71	
		37,137.43
Total cost to city of work		$18,490.85

*Data from recent report of Commissioner of Public Works.

Municipal Motor Cars versus Horse Vehicles—The city of Fitzroy, Victoria, Australia, recently installed a motor truck instead of a horse-drawn vehicle for the collection of refuse. A recent report gives the comparative figures of the motor-truck and the horse-drawn truck operation as follows:

For the six months ending Mar. 31, the motor truck, working 110 days, had taken 995 loads (3483 tons). It had run 4923 miles at a cost for gasoline of 4.48c. per mile. The total cost of the service, including interest, depreciation, employment of extra carts when the motor was not running, etc., was $6340. For the corresponding six months of the year previous, the horse-drawn vehicles, eleven in number, which did the same amount of work as the one-motor truck, cost $5670, so the cost of the motor truck was $670 greater than the horse-drawn vehicles. The officials state that in their opinion the motor effected a greater saving than is shown by the figures. They say that the truck had not been used in the way for which it was intended, and has taken on more work than the vehicle it displaced.

The Throttle Dam, Raton, N. M.; an Earth Embankment for Sudden Flood Waters

For most irrigation projects impoundment in reservoirs is gradual throughout the entire wet season. For such conditions a definite percentage of the seasonal rainfall may be assumed as a reasonable basis for computing the amount of water available for storage. The Throttle Dam, on the ranch of Thompson and Maloche about 15 miles southeast of Raton, N. M., was constructed to store the water of heavy freshets, where, owing to the nature of the catchment area, the total runoff occurs within a period of a few hours. Several prominent engineers reported unfavorably on the project, not daring to risk the construction of this type of dam at a site that was subject to freshets of over 15,000 sec.-ft. However, the embankment as built has stood without serious injury, despite the fact that twice during the course of construction, when the dam was two-thirds completed, flood waters poured over the crest and submerged practically the whole structure.

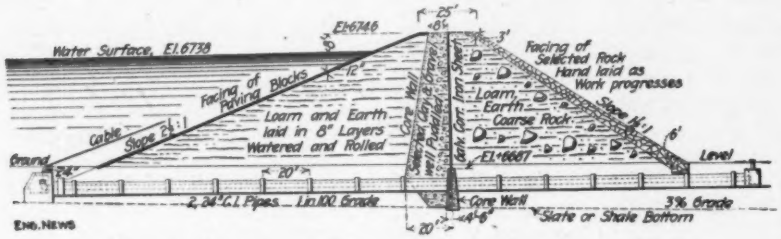


FIG. 1. DETAILS OF THROTTLE DAM NEAR RATON, N. M.

The purpose of this construction was to conserve water for irrigating portions of a 37,000-acre ranch where a prolonged dry period would mean the extermination of many head of cattle and stock. The reservoir has a capacity of 3000 acre-ft., which will be replenished twice during ordinary seasons. On the watershed above the dam site the average annual rainfall is 15 in. The catchment area is 58 sq.mi. It contains at the higher levels a large mesa which is so flat that in ordinary light rains there is practically no runoff from the cultivated lands thereon. The remainder consists of creek gorges. The rapidity of the runoff results partially from the steepness and bareness of the sides of these gorges, and partially from the fact that most of the rain storms are torrential. An investigation was made as to the feasibility of digging a diverting ditch 4½ miles long to lead flood waters for irrigation, the attachment from about 30 sq.mi. of the upper drainage area, to a desirable reservoir site on an adjacent mesa outside the shed. This plan was abandoned because it would be impracticable to make the ditch sufficiently large to divert even a considerable fraction of the freshet runoff, and due to seepage and evaporation such a ditch would be almost dry except at times of heavy downpour. The estimated cost for a ditch of this character was $44,900.

DESIGN

The Throttle Dam (Fig. 1) is 1060 ft. in length along the top and 77 ft. in height from the lowest point in the foundation to the crest. A concrete core-wall 600 ft. in length, 4½ ft. wide at the base and 2½ ft. at the top extends from bedrock to a height of 17½ ft. In front and above this is a puddle-wall of selected clay and gravel, of the dimensions shown on one of the drawings.

FIG. 2. VIEW LOOKING ACROSS THROTTLE DAM DURING CONSTRUCTION

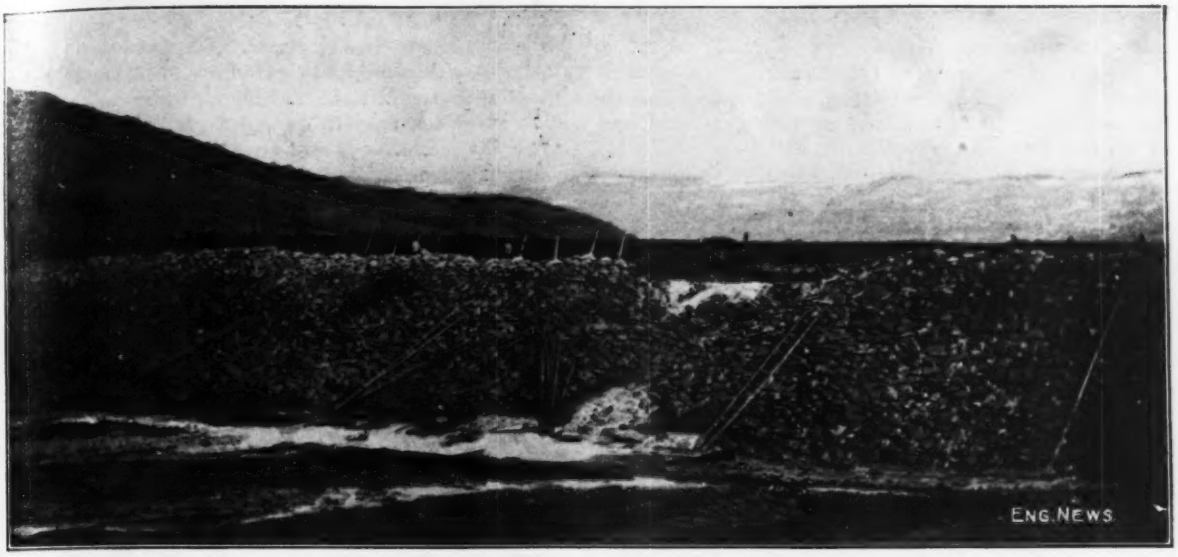


FIG. 3. DOWNSTREAM SIDE OF THROTTLE DAM, AFTER OVERTOPPING
(Only damage caused by flood was a small area old riprap washed out.)

This is completely faced on the downstream side with No. 12 gage galvanized corrugated ingot iron which extends from the concrete core-wall to the crest of the dam. The sheets composing this facing are 6 ft. long, have a side lap of 2½ in., a vertical lap of 4 in. and are riveted both ways with ⅜-in. rivets at 2¾-in. centers. The object of this sheeting is to prevent rodents from boring through the structure.

Upstream from the puddle wall the embankment consists of loam and earth thoroughly rolled and compacted, faced with basalt paving blocks having a uniform exposed surface, a minimum depth of 12 in. and a minimum weight of 50 lb. each. In the downstream portion, large rocks were compacted with the loam and earth and a rough rubble facing of rock 3 ft. thick at the crest and 6 ft. at the base was hand laid to a slope of 1½ to 1. Large trapezoidal spillways were provided on both ends of the dam, as shown in one of the drawings. Cutoff walls and aprons for the spillways were lined with concrete.

INTAKE CONTROL

Water is drawn from the reservoir through two 24-in. cast-iron bell-and-spigot pipes, incased in concrete, carried from bedrock through the base of the dam, laid on a 1% slope. No gate tower was erected over the intakes but an auxiliary emergency device arranged by which the flow could be controlled from the crest of the dam. At the reservoir end of each 24-in. pipe a quarter-bend elbow is attached and turned upward so that the intake is horizontal. In the open ends of the elbows are fitted cast-iron valve caps which may be lifted to permit the inflow, by means of a plow-steel cable 1⅛ in. in diameter. This cable is led over 24-in. sheave wheels to a multiple-pulley windlass on the dam crest (Fig. 4). The amount of water drawn through the intakes is controlled by two 24-in. valves in an ice-proof shed located 141 ft. 7 in. downstream from the center line of the crest. This type of control is more economical than providing an intake tower within the reservoir, as very heavy construction would be necessary for such a tower to be able to resist the impact of large masses of floating ice, frequently 24 in. thick, common in that locality.

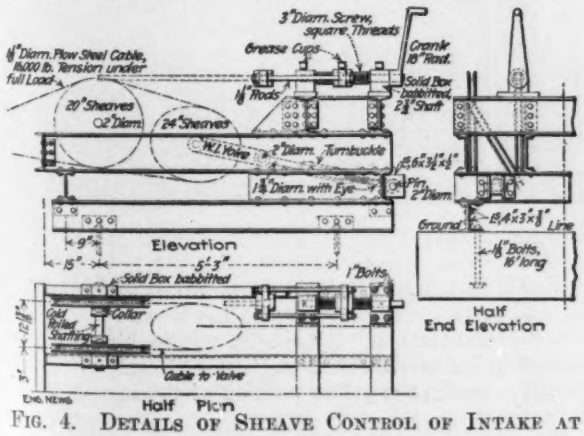


FIG. 4. DETAILS OF SHEAVE CONTROL OF INTAKE AT TOP OF DAM

CONSTRUCTION

Earth and rock for the embankment were excavated from the adjacent hillsides with a steam shovel. This material was conveyed to the dam in 2-yd. dump wagons (Fig. 2). The earth was spread in 8-in. layers with wheel and Fresno scrapers and thoroughly wet by hosing. A four-horse roller weighing one ton per lineal foot of tread and consisting of a number of railroad car wheels, compacted this material.

Concrete for the core wall was mixed in a 1-yd. batch mixer. The proportions were 1 part cement, 2½ sand and 5 crushed rock. A special alkali-proof, slow-setting cement was first used, but although the proportions were accurately measured and care taken in mixing, it was discovered that after the concrete had been in place for five weeks it showed no signs of setting, and fell apart from its own weight when exposed to the action of seepage water. This defective concrete was removed, the cement condemned as unsatisfactory, and a standard portland cement substituted. No trouble was experienced with the latter brand. The reservoir has been filled to

the spillway level, and there is absolutely no leakage through the structure.

The cost of the dam and appurtenances was approximately $200,000. M. M. O'Shaughnessy, acting as Consulting Engineer, was in charge of the design and construction. The work was done by day labor under his directions. H. W. Blackburn was Resident Engineer.

A Machine for Laying Brick or Block Pavements

A machine has been designed and patented which will level, smooth and compact a sand or wet concrete base and lay automatically consecutive rows of brick or other kind of paving blocks, closing the joints, rolling the paved surface and leaving it ready for the joint-filling operation.

The machine travels on rails, laid carefully to a correct grade, on both sides of the strip to be paved. It is obviously intended only for straight stretches of uniform width of paving. If the machine is motor-operated, the only manual labor necessary, other than that required of the operator, is the feeding of the blocks into V-shaped troughs on the sides of the machine.

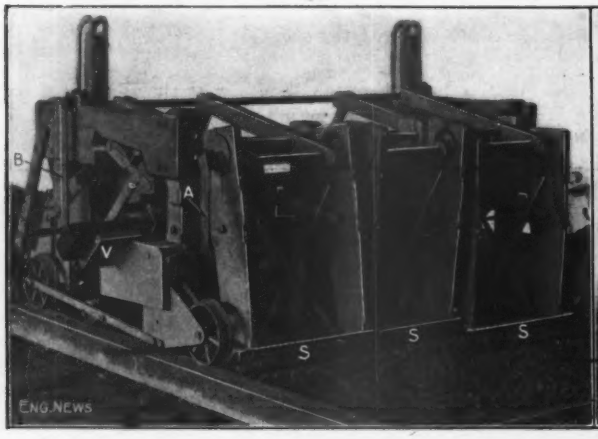


FIG. 1. FRONT VIEW OF EXPERIMENTAL PAVING MACHINE INVENTED BY WILLIAM BAYLEY

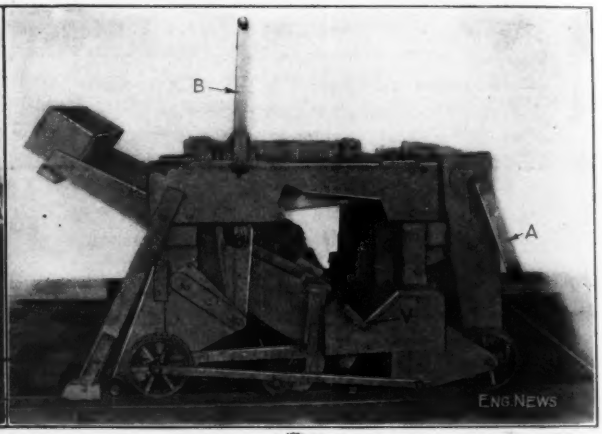


FIG. 2. SIDE VIEW OF BAYLEY PAVING MACHINE

The illustrations, Figs. 1, 2 and 3, show the front, side and rear, respectively, of an experimental machine built to lay a 6-ft. strip of paving. The front has three separately operated shovel edges *S*, which by means of cams and levers, have a shoving and up-and-down motion which rolls the sand or wet concrete ahead of the machine and smooths and presses the bed in advance of the bricks. The shovels can be detached from the links in the center and thrown over the shaft on top of the machine, so that any cleaning up can be done, as when commencing or stopping work. The V-shaped trough *V* (at the left in Fig. 1) is for feeding th blocks into the machine, which, in the case of this experimental one, is operated by turning the cranks *A* and *B* by hand.

OPERATION—To make clear the operation of the paving machine reference to Figs. 4, 5, 6 and 7 is essential. Fig. 4 shows the shovel arms 3 in normal position. The front shovel 4 is moving the excess sand or concrete ahead, and the back one 6 is acting as a rammer and smoother. The block box 1 is shown full with a row of blocks. The dotted line 7 is the path of the blocks while in the act of being placed. The links 8 and 9 and the bent connection 10 swing from the block placer, being hung on shafts 11 and 12. They lift the block placer by means of contact with the stop angle 13, which extends across the machine. There are three sets of these links and connections on the machine.

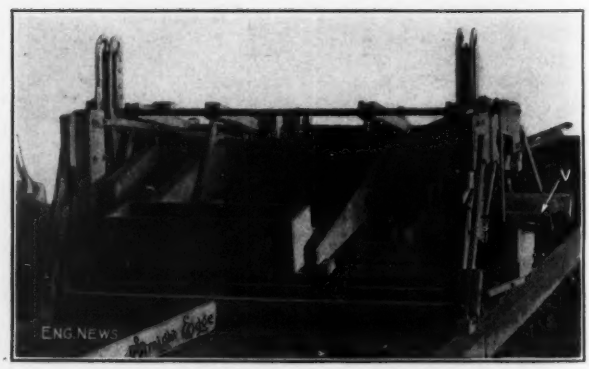


FIG. 3. REAR VIEW OF BAYLEY PAVING MACHINE

When the block-placer descends to the position shown in Fig. 5, the fingers 14, which are attached to the hinged angle, or box end 15, come into contact with the shaft 17, which arrests the descent of 15, whereby the continued descent of 1 opens the rear end of the block-box and prepares a way for the blocks to pass out.

The box-front 15 is hinged at point 16. The box-frame 1 continues to descend and opens the block-box until the position shown in Fig. 6 is reached. The box 1 is now on the paving bed and has reached the end of its movement and has delivered the row of blocks on the paving bed, abutting those previously laid; except that the bottom plate 1 is still under the row.

The bottom plate 1 is rigidly attached to the beams 37 as well as to the angle 18, which has an end extending out over the track at each side of the machine. These ends stop the movement of the beams 37 and the block-box 1, as well as gage the position of the row of block from the tracks.

The links 8 and 9 and the arms 19 with the connection 10 continue to swing back away from the stop angle

13, being propelled by the arms 19, which are on each side of the machine and are moved by the racks 20 until the end of the rack movement is reached, as shown in Fig. 7.

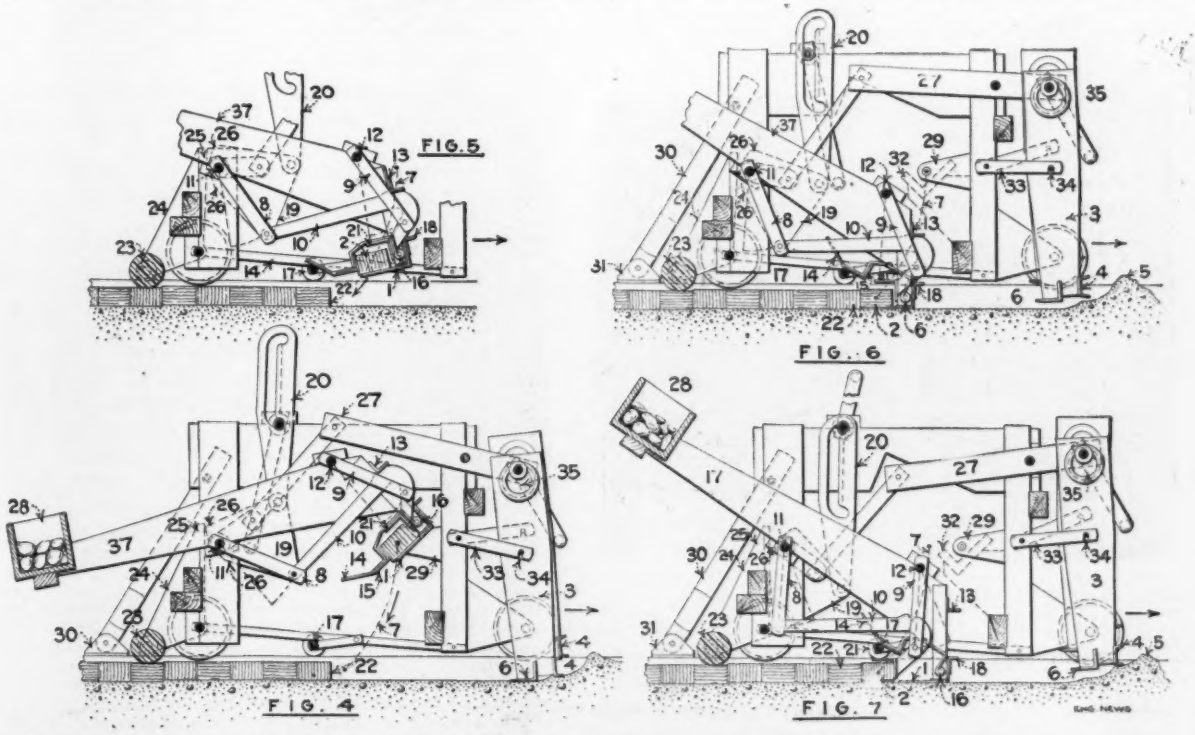
The angle 21, which extends across the machine and forms the front of the block-box, and is connected to the ends of connection 10, has pressed against the row of blocks 2 continually through this last movement, the whole machine is advanced by the pressure exerted against the shaft 11. Or in other words, the lower centers of links 8 and 9 and arms 19 remain stationary along the paving bed while the top centers, shafts 11 and 12 and the frame of the machine holding them, move forward.

This withdraws the plate 1 from under the row of blocks and passes the angle 15 over them. It will be seen that the row 2 has passed out of the machine, but by reason of the pressure exerted against it by the angle 21 it is still clamped between angle 21 and the row of blocks 22 already laid. Hence, there is a clean, close joint between the rows 2 and 22, and row 2 is held suspended until the reverse action of the rack 20 takes all the parts back through the different positions shown by Figs. 4, 5 and 6.

As the machine is advanced, the roller 23 settles each row in turn, with all the pressure that is possible to put upon it. The roller 23 runs on its own wheel on the track. It is trailed from the rear axle of the machine by arms 24. These arms 24 have extensions 25, which come in contact with cams 26 at each end of the movement of the arms 19, of which the cams 26 are a part. Heavy contact at this point lifts the rear wheels from the track about ⅛ in. and thus throws all the weight of the rear of the machine on the roller and settles the blocks effectively.

In Fig. 6, the shovels 4 and 6 are being raised away from the paving-bed by the arms 27, until, as shown in Fig. 7, they have reached their greatest height. This raising movement prevents the shovels from being shoved into the mass of material in front of the machine and thus choked, but allows them to move this material forward gradually by taking off the top in small quantities, and gradually ramming down and finishing the bed. This is an important part of the working of the machine, for it is designed not only to make a good solid true bed, but to divide up the work of the machine so that when it is shoveling it is not placing blocks, and when placing blocks it is not shoveling.

In Figs. 4-7, the part 28 is a counterbalance box for the block placer; 29 is a stop for feeding the blocks into the machine. This experimental machine is fed from one side, but larger machines will be fed from both sides against an automatic adjusting stop in the center and by two or more men. The part 30 is a pawl to resist backing and opposes the tendency of the shovel to back up the machine. The links 33 can be raised off of the pin 34 and turned up over the eccentric 35. When this is done, access is had to the paving-bed back of the blocks.



FIGS. 4-7. SHOWING VARIOUS STEPS IN OPERATION OF BAYLEY PAVING MACHINE

It is evident that the machine may be used for leveling cement or bituminous concrete as well as for laying blocks. To date, it has been used only for some factory floors, shown in the accompanying views, Figs. 8 to 10. It is claimed to be particularly adaptable to bedding brick or blocks directly in the soft concrete base, without the use of a sand cushion. In the views of the machine shown, it is being operated with asphalt blocks 5x12x3 in.

Two men working with this experimental machine laid 135 sq.yd. of brick pavement in a 9-hr. day, or at a labor cost of 3.67c. per sq.yd. With motive power, it is estimated that the cost would be about half. The

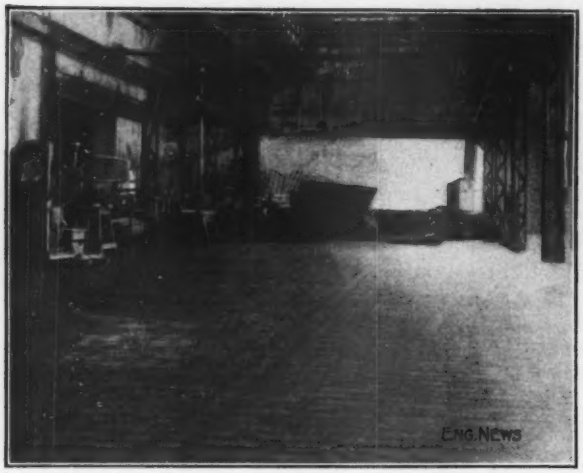


FIG. 8. ASPHALT-BLOCK FACTORY FLOOR LAID WITH BAYLEY PAVING MACHINE

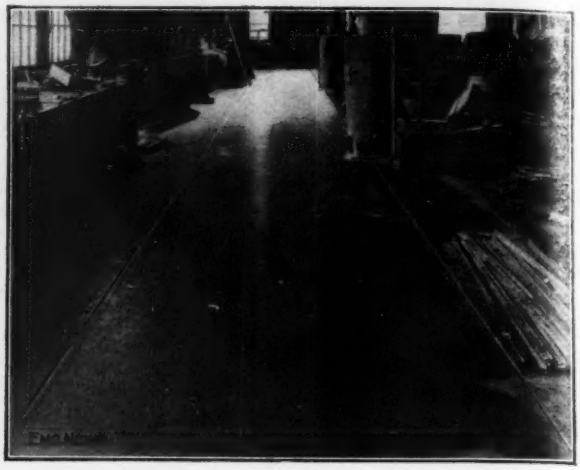


FIG. 9. CONCRETE PAVEMENT LAID WITH BAYLEY PAVING MACHINE

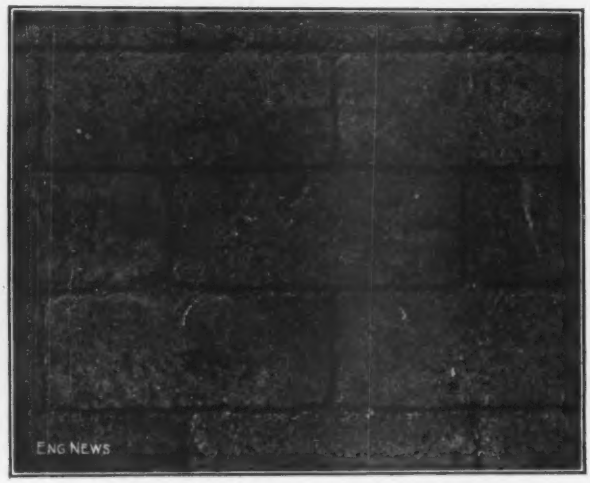


FIG. 10. ASPHALT-BLOCK PAVEMENT, SHOWING CLOSENESS OF JOINTS

speed at which this machine operated was limited by the speed with which the cement grout could be delivered in front of it. A larger machine would have an automatic block or brick feeder, which would also economize time.

The apparatus described is known as the Bayley Paving Machine, invented and patented by William Bayley, President of the William Bayley Co., steel-sash manufacturers, Springfield, Ohio.

Cement Joints for Sewer Pipe at Edmonton, Alta.

By J. M. Begg*

The difficulty of getting in Edmonton a sufficient number of skilled pipelayers and inspectors has led me to consider carefully present methods of making cement joints in sewer pipe. It is a simple series of operations and yet like many other simple things it is not always well done. Perhaps it is just because it is a common daily part of the work, that it is apt to be overlooked.

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Once a sewer is covered up, and the sewage entering it gets away freely, it is assumed that the sewer is in good working order, but that is not always so. The sewage may be getting out, or ground water may be getting in to an extent that seriously decreases the capacity of the sewer.

The common method of specifying sewer joints is to require a strand of oakum or hemp gasket all around the inner part of the joint and cement mortar to fill up the rest of the jointing space. The gasket prevents the mortar from entering the barrel of the sewer. In making a joint of this kind, the usual procedure is to dig a hole under the bell of the pipe last laid, insert the next pipe, calk the gasket all round the joint and complete the joint with cement mortar, using the hands to get it in under the pipe. From Ogden's "Sewer Construction," I take some directions typical of those which cover this method:

> All pipes and special shall be laid to the grade given by the engineer . . . special care being taken that there is no sagging of the spigot end in the hub. . . . A narrow gasket of jute shall be provided by the contractor, to be well soaked in neat cement grout and introduced between the hub and spigot, and well and properly rammed. It shall in all cases be driven to the bottom of the hub to leave room for the mortar as specified. The space between the spigot and hub shall then be entirely filled with mortar thoroughly pressed in on the bottom, sides and top, and every precaution taken to secure a watertight joint. The mortar shall be applied with a rubber mitten and rammed or compacted with a wooden calking tool. The joint shall be finished with a neat and generous bevel made with the mitten.

A careful and conscientious pipelayer can make an excellent joint in this way; but it is obvious, that, if he is at all slovenly, the lower half of the joint, which in a sewer is the vital part, is more likely to suffer. It is the most difficult part to get at, and the larger the pipe the greater is the difficulty. The danger is increased if the contractor is pressing the pipelayer to get along quickly and if the inspector is inclined to keep to the top of the trench. From that position he cannot see what the pipelayer is doing with his hands under the pipe. On a small job, where there is ample opportunity for careful inspection, and time is available, the method is not likely to be found unsatisfactory, but with thirty or forty miles of construction to cram into six months, I have found it apt to break down here and there.

If the pipelayer has any latitude at all, as often as

or he backslides and adopts another and easier method. Before laying any pipe, he places some mortar in the lower part of the bell of the pipe already laid, inserts the next pipe, and then finishes the upper part of the joint with oakum and cement, or with cement alone. Such a method leaves little chance of a leaky joint below the water run, but another danger is incurred. In the very act of inserting the pipe, the pipelayer is likely to squirt some of the mortar into the barrel of the sewer. This mortar, of course, can easily be removed with a scraper or a tight-fitting bag, but the pipelayer again may neglect to do this and the inspector may fail to detect it in one or two lengths.

I do not see how one can avoid running one or other of these two dangers. The engineer, who cannot always be on the job himself, can only choose the method that seems to him to offer the least chance of being carelessly carried out. The one method—calking oakum all round the joint before adding any mortar—involves the risk of a leaky joint, owing to the irksomeness of getting mortar into the bottom; the second method—placing mortar in the bell before introducing the next pipe—involves the risk of cement getting inside the sewer and forming a little ridge across the water run. In spite of this possibility, I have come to think this latter method the less dangerous. As a rule, not a great deal of cement does actually squirt through into the sewer, and the pipelayer has little temptation to omit cleaning out what does get in. Incidentally, I prefer the wooden scraper to the bag hauled through the sewer with a rope as pipelaying proceeds.

But many engineers who specify this method of first lining the bell with cement overlook an important point. Cement mortar alone in the bell will not support the spigot end of the next pipe. The spigot sinks down into even the stiffest mortar, and if the whole line is laid in this way you get a water run like the edge of a saw. Very little pressure is required to squeeze down the pipe into the bell. If the pipelayer steps on the pipe or if the backfilling is thrown on top of it while the mortar is green, it is enough to cause it to sag, even if the weight of the pipe itself does not carry it down. It is advisable, therefore, to lay a piece of hemp, about 6 in. long, on the lower part of the bell and then place the mortar on top of it. This may seem a clumsy proceeding but, if you try to introduce the hemp afterward, you will find you need to calk it away into the bell to raise the pipe, and in the larger diameters it is hard to raise the pipe in such a way at all. To raise the pipe with a chip of wood in the bell will not do as it lifts the spigot off the mortar, and any method of making the pipes concentric which depends on a finical trimming of the trench is not likely to be very successful. Hemp gasket is about the best and handiest material, but just before being used it should be dipped in neat cement grout.

In his "Engineering Work in Towns and Cities" (1908) Ernest McCullough quoted from ENGINEERING NEWS a specification which reads in this way:

> **Joints shall be made as follows: (1) Line with mortar the lower third of the entire circumference of the bell; (2) insert the pipe to be laid and a jute gasket freshly dipped in neat grout; (3) bring the pipe to grade and line; (4) calk the gasket tightly into the joint; (5) fill the joint with mortar mixed rather stiff, using a rubber mitten; (6) tamp mortar into joint with an approved tool until it is solidly filled; (7) smooth on mortar, using a rubber mitten; (8) protect the cement (preferably with burlap) and fill around the barrel of pipe with sand or similar material, tamping solid with an approved tool; (9) remove burlap and cover joint and pipe with fine material; (10) clean out and point joint on inside of pipe.**

This is a better clause than is found in most specifications, though the manner of conducting operations (2) and (3) is not very clear. Mr. McCullough, in a note, states that he fails to see the necessity for specifying a gasket in sewer-pipe joints, except when the sewer is laid in water. But, as a few minutes' experimenting on the ground will show, it is difficult to get an even water run without the gasket in the bottom. The gasket in the top half of the joint is, of course, a safeguard against cement getting into the pipe. It may be argued that as we have to clean out any cement that gets in at the lower part of the joint, a little from the upper part will not materially add to the danger; but it is advisable to reduce the danger to a minimum.

The following is the specification we use at present in Edmonton:

> **The ordinary joint shall be made in the following manner:**
>
> **(a) Lay along the lower quarter of the bell and just at the entrance a piece of Russian hemp or other approved material freshly dipped in neat cement grout. This hemp is to keep the pipe to be laid next from sinking into the mortar in the bell and must therefore be thick enough to keep the pipes concentric.**
>
> **(b) Line the lower third of the bell with stiff mortar, covering completely the strand of hemp.**
>
> **(c) Insert the pipe to be laid, pushing it home until it is hard against the inner end of the bell. Great care must be taken to see that the spigot end of the pipe rests on top of the hemp and does not catch it and jam it back into the bell.**
>
> **(d) Calk into that part of the bell not already filled with mortar a strand of gasket freshly dipped in neat cement grout. This gasket after calking must not take up more than one-quarter of the space available in the bell for the whole joint.**
>
> **(e) Fill the joint all the way around with stiff mortar, using a rubber mitten, and finish off the outside of the joint both top and bottom with a neat bevel. But no joint is to be completed in this manner until at least two joints have been calked in advance with the gasket as described in paragraph (d).**
>
> **(f) Clean all cement from the inside of pipe up to 15 in. diameter by using a wooden scraper made in the form of a semicircle. Pipes over 15 in. and less than 22 in. diameter to have the lower half of the joints pointed on the inside. Pipes 22 in. diameter and over to have the joint pointed all the way around on the inside.**

The method so specified is no doubt open to criticism but it is an attempt to work out a method which, taking full account of human nature and the actual conditions of pipelaying, should reduce the danger of leaky joints to a minimum. The trouble is not that a contractor may be dishonest. A good joint can be made about as easily and cheaply as a bad one. The trouble is simply that the pipelayer may find it awkward to make the bottom of the joint carefully and it is important to have a standard method that insures easy inspection and leaves as little room as possible for careless workmanship. There is nothing in the method suggested which a contractor could consider a hardship. It is easier than the method of calking a gasket all the way round before adding the cement, and it takes the same material. The latter method is almost sure to lead to leaky joints, if inspection relaxes for even a short time, or if the work is at all hurried.

It might after all be argued that the method I have recommended needs rigid inspection just as much as the other. It does need careful inspection, but this much at least can be said for it that once a pipelayer becomes accustomed to it there is little or no temptation to depart from it even if the inspector's back is turned.

Field and Office

Trenching a City Street for a 15-ft. Sewer

A very large trunk sewer in the Borough of Brooklyn, New York City, is being constructed, through some of the older sections of the city, with so little interference to street traffic that quite a thorough search of the locality has to be made to find the places where work is under way. Although the trench occupies nearly the full width

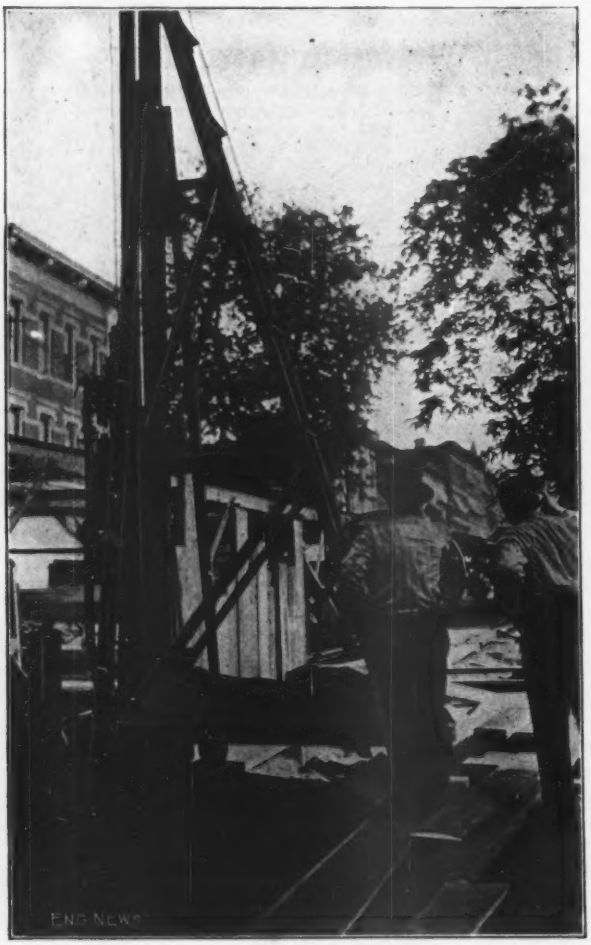


FIG. 1. TRAVELING STEAM-HAMMER PILEDRIVER

of the street and is about 40 ft. deep in some places, the work is so expeditiously handled that less than a block is open at any one time. Within that distance, the excavation is made, the 15-ft. diameter reinforced-concrete arch sewer is built, and the backfill made, simultaneously.

DRIVING THE SHEETING—The timber sheeting is driven on both sides of the trench at the same time by two steam-hammer piledrivers, taking steam from a portable 40-hp. boiler near at hand through pipe and flexible hose connections. The piledrivers are mounted on travelers (Fig. 1) which run on light rails parallel to the trench.

Over the trench, on the top braces of the sheeting, are laid the rails which carry the light-steel trestle (Fig. 2) of the sewer-trenching machine; each post of the trestle is mounted on a wheel, which enables the whole outfit to be moved forward. The diagonal timber braces were added to the trestle framework by the contractor to give additional rigidity.

TRENCHING MACHINE—The illustration (Fig. 3) shows a Potter sewer-trenching machine (described in ENGINEERING NEWS, Apr. 28, 1898), which has been used considerably throughout the Middle West, but is little known to many Eastern contractors. This machine consists of a hoist traveler carried on the light-steel trestle shown in Fig. 2.

The traveler with loaded buckets is moved rapidly to the rear by a cable which starts from the upper drum of a 7x10-in. hoisting engine (in the shack at the left), passes along the trestle over the traveler, around a tail-block pulley or sheave at the far end of the trestle, and returns to the traveler, where it passes around a bull wheel, to which it is attached. Another cable starts from the lower drum of the hoisting engine and goes directly to an eye or ring on the front of the traveler. This cable holds the traveler stationary while the buckets are raised and lowered, and pulls it forward after the loaded buckets have been dumped. The buckets are raised and lowered by the main cable winding and unwinding on the bull wheel.

The traveler is moved by the engineman in the shack on signals from a man on the traveler. The buckets are cylindrical in shape, and hold 1 cu.yd. They are managed by the man on the traveler.

EXCAVATION—The excavation is chiefly in sand. The earth is excavated by hand and raised in the buckets, 12 of which are constantly in use; two buckets at a time are run back on the traveler and dumped into one of two hand-pushed 2-cu.yd. tip cars, running on a narrow-gage track, laid on the planked-over trench bracing of the completed sewer and backfill. The cars are handled and dumped by two men. There is very little loose earth to be taken care of, for after the material from the first cutting is taken away the material from the remaining excavation is dumped directly into the backfill as fast as it is excavated.

The excavation amounts to about 30 cu.yd. per lin.ft. of trench, and the machine handles about 250 cu.yd. per day of 8 hr., or makes a progress of 8 ft. of sewer per day, with a force of about 60 men.

CONCRETING—Following the piledrivers, on the left-hand side of the street, is a steam-engine-operated 17-cu. ft. concrete mixer (Fig. 4) which dumps directly into a chute leading to the forms for the arch sewer. Steam is furnished by the same portable boiler which supplies the piledrivers. About 30 laborers are engaged in the concrete work and two masons on the brick invert. The

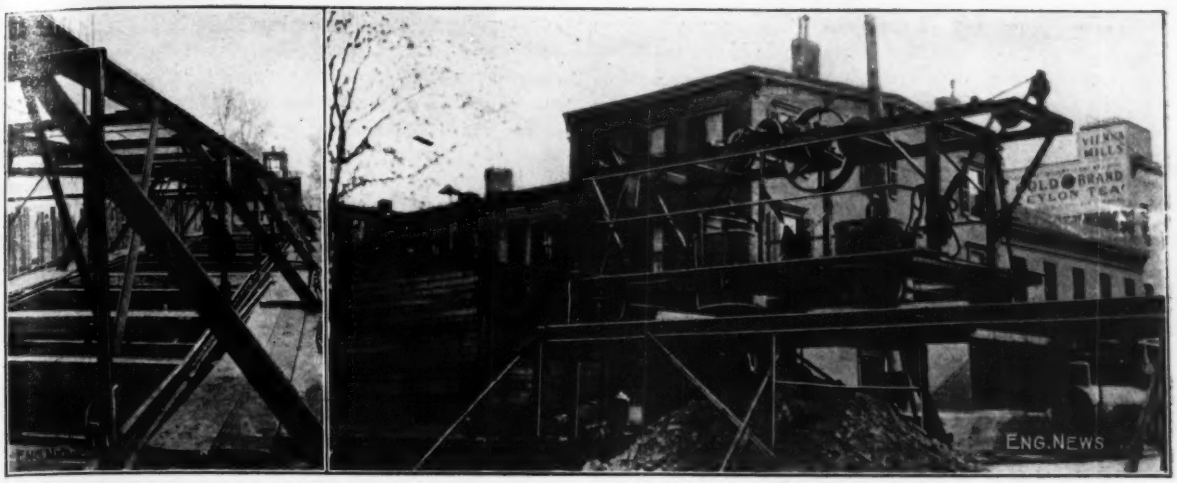


FIG. 2. TRAVELING STEEL TRESTLE FOR TRENCHING MACHINE

FIG. 3. POTTER SEWER-TRENCHING MACHINE, TOMPKINS AVE. SEWER, BROOKLYN, N. Y.

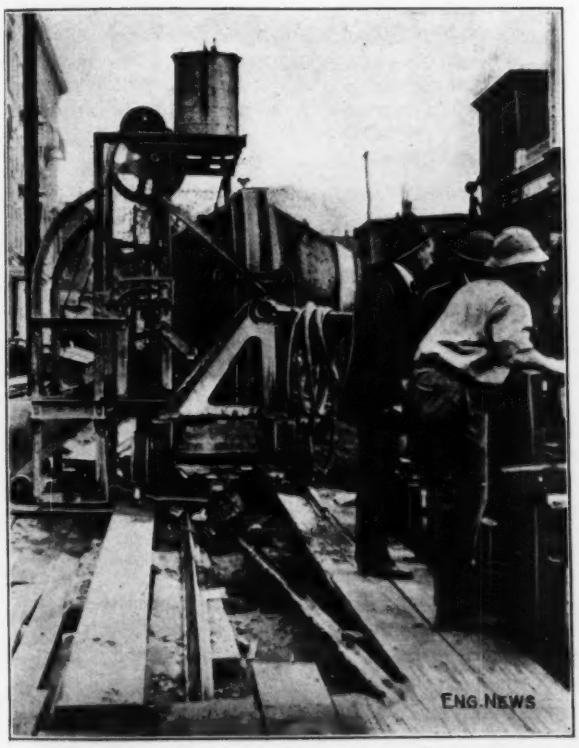


FIG. 4. TRAVELING CONCRETE MIXER, TOMPKINS AVE. SEWER

concrete work is, of course, so gaged as to keep pace with the excavation, and *vice versa*.

As soon as the concrete is sufficiently set, the backfill is continued over it. The bracing and sheeting remain in, and the street surface restored to use. About 100 men form the whole force engaged.

The contractor, John J. Creem Co., of Brooklyn, N. Y., has three such outfits on the same sewer contract, working independently on different sections of the work, which is under the supervision of E. J. Fort, Chief Engineer of the Bureau of Sewers, of Brooklyn.

The Removal of the Old Jackson St. Bridge at Chicago

The superstructure of the old Jackson St. bridge over the Chicago River at Chicago was removed in very short time, in May last, by cutting it apart with blowpipes and swinging the several parts onto barges by means of a derrick boat with 60-ft. steel boom.

The old bridge (built in 1888) had a three-truss swing span (with through trusses) 280 ft. long and 58 ft. wide, the east arm of which spanned the navigable channel of the river. The west arm spanned team driveways and freight tracks, beneath which was a bypass to give the necessary flow capacity to the river. The removal of this bypass, to make room for the new bridge, was described in our issue of Aug. 28, 1913, this bridge being built to give a greater width of channel, as required by the U. S. Government.

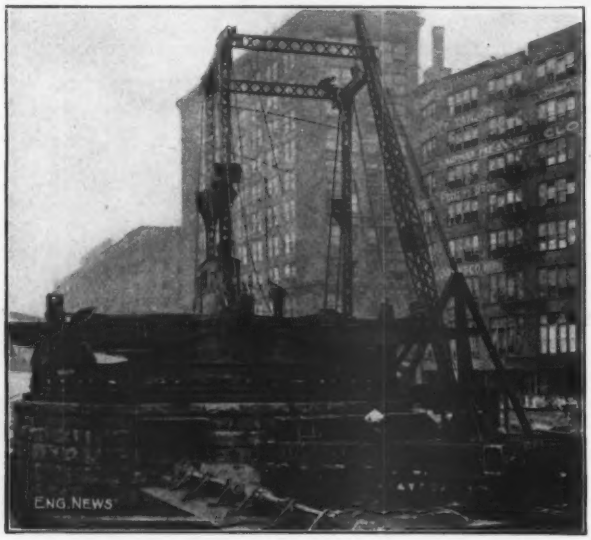
The new west abutment is close to the west side of the old center pier, and work has been commenced on the foundation for this. The coffer-dam has a single row of steel sheet piling, with heavy timber bracing. The weight of the adjacent pier and swing span, and that of the west retaining wall of the bypass, made it impossible to maintain this coffer-dam water-tight when excavating within it, particularly for the open wells which are to be sunk to rock for cylinder piers supporting the abutment. Therefore, it was considered better to remove the old bridge at once rather than to reinforce the coffer-dam at considerable expense.

Careful investigation showed that two high brick buildings on the east side of the river at Jackson St., built on pile foundations, must be placed on piers resting on the bedrock before it would be safe to put in the east abutment. The delay on the contract due to the construction of these piers under the buildings threw the removal of the old superstructure of the bridge into the season of navigation, while according to the contract and the arrangements originally planned, this span was to be removed in the winter time.

The cutting was to have been done with the Great Lakes Dredge & Dock Co.'s floating electric welding plant, which is provided with electric arcs for cutting as

well as welding, but at time the bridge superstructure had to be taken down (May, 1914), this plant could not be spared from its regular repair work on the fleet of dredges, tugs, etc., in the Chicago harbor. So it was decided to do the cutting with blowpipes, as it was important to avoid all possible delays to navigation at this season of the year in the busy Chicago River. The current at the bridge channel is about three miles per hour.

The bridge (weighing about 600 tons) was swung to the open position, and the flooring torn up. The stringers were first cut away with the blowpipes, after which the floorbeams were cut loose in the same way. As the floorbeams were removed, the chords and diagonals were cut near the panel points, and the severed sections swung onto barges by the derrick boat. Work was done from both ends so as to keep the remaining part of the structure in balance, as no falsework was used, and it was



REMOVAL OF THE JACKSON ST. BRIDGE, AT CHICAGO, BY CUTTING THE MEMBERS APART WITH BLOWPIPES

necessary to maintain a nice poise as the truss action of the remaining members was much impaired.

The accompanying cut shows one of the top-chord sections of the center panel of a side truss being held by the derrick boom while a man is cutting it loose at the farther end with a blowpipe. The view shows also the severed sections of the three bottom chords, with one of the plate-girder floor-beams resting on the turntable. The small cabin in line with the center truss is the operator's house, the bridge having been operated by electricity.

The girders and members were cut mainly to 16-ft. lengths for removal, and will be cut with blowpipes to 5-ft. lengths for charging to furnaces as scrap. The thickness of the members cut varied from ¾ in. to 3 in., and where parts overlapped the thickness was as much as 6 in. Different types of blowpipes were used (the Oxweld, the Davis-Bournonville, the Engineering Sales Co. and the American Boiler Welding Co., but most of the work was done with those of the Oxweld Acetylene Co. Not more than two operators were engaged in cutting with blowpipes at any one time. The entire work occupied 12 days, including the removal of the turntable, leaving the masonry piers bare. It is believed that the acetylene torch or burner has some advantages over the electric arc in cutting steelwork, in that it cuts a narrower groove and is more easily manipulated than the latter.

In regard to removal by other methods it is stated that it would have taken at least four weeks to cut the rivet heads, drive out rivets, and chip or cut the members into the necessary lengths. In this case also there would have been required a greater amount of equipment in the way of air compressors, air hammers and chisels, and other tools, and probably falsework, together with more laborers and operators, while there would have been a greater amount of work in handling the parts by the derrick boat. The method employed effected a great saving of time and the delays to navigation were reduced to a minimum, this being an important item.

The new bridge will be a double-leaf trunnion bascule structure of the Strauss type, with deck trusses, having a span of 202 ft. 3¼ in. c. to c. of trunnions and 182 ft. c. to c. of front bearings, while the clear width of channel will be 168 ft. The bridge will have a 37-ft. roadway and two 13-ft. sidewalks. The substructure will include two masonry abutments, each supported on four concrete piers sunk to rock at a depth of 90 ft. below datum. The contract for the superstructure was let to the Strobel Steel Construction Co., and the contract for the substructure was let to the Great Lakes Dredge & Dock Co., both of Chicago. The substructure contract included the removal of the old superstructure (as described above) and the old substructure.

Some Neglected Points in the Theory and Adjustment of the Wye-Level

BY J. A. KITTS*

Although the wye-level was invented 174 years ago (by Jonathan Sissons, of London), the writer does not believe that this instrument is generally understood, particularly in the method of use, by young engineers.

Two general methods of setting up a wye-level are used, one consisting of bringing the bubble to the center of the tube, and the other of bringing the vertical axis into a vertical position. The writer believes this latter method to be the proper one, and adjustments to suit this method are outlined herein. The former method is the more common practice; there seems to have been little said or written about the latter method, and it is the first impulse of the novice with spirit-level instruments to center the bubble, little understanding why he does so.

This practice of keeping the bubble in the center of the tube leads to error, as in the best of instruments the grinding or calibration of the bubble tube is such that the bubble centers differently for different temperatures; and the relation between the line of sight and the bubble position is therefore not amenable to fine adjustment.

The levelman centering the bubble for every observation at a different angle has no way of detecting the change of the relation between the tangential axis of the bubble tube and the line of sight, until the instrument is very badly out of adjustment. Unless he has time to

*Balboa, Canal Zone, Panama.

check the adjustment often, here is another source of error. On the other hand, if the levelman levels so that his vertical axis is kept vertical, he becomes thoroughly acquainted with his instrument, knows where his bubble centers for varying lengths of the bubble due to atmospheric changes, and thus has an index to any changes in his instrument.

The wye-level was designed with the object of utilizing the principle of reversion to adjust the line of sight perpendicular to the vertical axis, and, by keeping the vertical axis vertical, maintaining the line of sight in a horizontal plane. In a completely adjusted wye-level the line of sight is necessarily perpendicular to the vertical axis of the instrument, and for successful operation the vertical axis should be kept vertical (operation 2, as given below), and it is not essential that the bubble rest in the center of the tube.

Keeping the vertical axis vertical is easily accomplished by use of the leveling screws in bringing the bubble into a position where it will remain for any angle of the telescope about the vertical axis. This does not depend upon the bubble axis being adjusted parallel to the line of sight but does depend upon the spindle and bearing fitting properly and not being worn elliptical in section. This provides an index to a defect in the spindle.

The line of sight can be adjusted perpendicular to the vertical axis (operation 3*ab*) with fine accuracy depending upon the telescope collars being true circles of the same diameter. This is an index to a defect in the collars; (3*a*) and (1) cannot be accomplished if the collars are not of the same size and circular.

In a theoretically perfect wye-level the following specifications obtain:

(*a*) The object and eye glasses are perpendicular to the optical axis.

(*b*) The optical axis coincides with the axis of rotation in the wyes.

(*c*) The line of sight coincides with the axis of rotation.

(*d*) The line of sight is parallel to the tangential axis of the bubble tube.

(*e*) The collars resting in the wyes are true circles of equal diameter and concentric with the line of sight.

(*f*) The wyes fit either collar in exactly the same manner.

(*g*) The bubble moves over equal spaces for equal displacements of the telescope in vertical arc.

(*h*) The bubble expands or contracts equally from the center in both directions in changes of temperature.

(*i*) The vertical axis is perpendicular to the line of sight, or horizontal axis of the telescope.

The maker of the better class of instruments meets these specifications with a fine degree of precision, excepting in simple bubble tubes, specification (*h*), and, as been pointed out, this is not essential if the proper method of leveling the instrument is used.

Items (*d*) and (*i*) often require readjustment in the field, and the following procedure is suggested:

Wye-Level Adjustments and Use

(1) Make line of sight coincide with axis of telescope collars:

Clean collars and wyes. Level sight at point and clamp vertical axis. Revolve telescope 180° in wyes. Note vertical and horizontal displacement from the point. This is twice the error. Adjust cross-hairs and repeat until they remain on the point through 360°. Clamp telescope in normal position, unclamp vertical axis, and see that point follows horizontal hair when turning instrument about vertical axis.

(2) Make the vertical axis vertical:

Level over both screws, bringing the bubble to the center. Note end of bubble nearest the eyepiece. Rotate instrument 180° about the vertical axis and again note eyepiece end of bubble. Correct one-half the interval over both pairs of screws. The bubble will then remain in the same position for any angle of the telescope about the vertical axis and the vertical axis is then vertical.

(3) Make horizontal axis of telescope perpendicular to vertical axis:

(*a*) Keep vertical axis vertical by (2), having clips loose. Reverse telescope in wyes and again note end of bubble toward eyepiece. Adjust wyes to correct one-half the interval. The bubble then assumes a new position for (2).

(*b*) Check this adjustment by sighting on distant point, reversing telescope in wyes and again sighting on the point, keeping vertical axis vertical by (2). Adjust wyes for one-half the interval between sights.

(4) Bring bubble to center of tube:

(*a*) Make vertical axis vertical by (2). (*b*) Adjust bubble tube until bubble comes to center. Repeat *a* and *b* until bubble remains in center through 360° about the vertical axis.

(5) Bring bubble axis into vertical plane through axis of telescope: Level by (2) observing that bubble tube hangs in normal position under the telescope. Rotate the telescope slightly in the wyes, noting position of bubble for swings to right and left. If the bubble runs toward the eyepiece when swung to the right the end of the bubble tube toward the eyepiece is too much to the right, or *vice versa*.

(6) Repeat and check all adjustments as any one adjustment may affect another. However, this method of adjustment makes each adjustment as nearly independent as possible.

(7) In using level, level by (2) as calibration of bubble tube is usually such that bubble center is different for varying temperatures. The vertical axis should be kept vertical, as the line of sight is adjusted perpendicular to the vertical axis thus obviating releveling when taking observations at various angles, and thereby effecting an economy of time and labor.

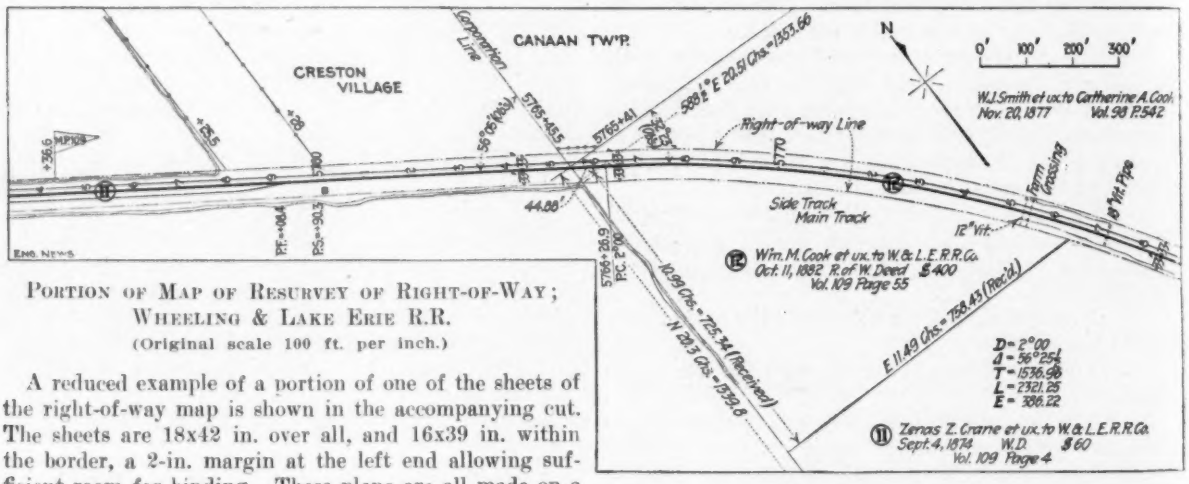
(8) Make line of sight coincide with optical axis: This adjustment is seldom necessary. If a distant object appears to shift position with reference to the aperture when revolving the telescope in the wyes, center the eyepiece until no movement is observed.

Making Permanent Record Maps Instead of Field Notes—To bring the records of street subsurface structures up-to-date, one man experienced in field surveys and drafting work was assigned from each highway district office in Philadelphia, Penn., in 1913. The use of field books was discontinued. The note-books were replaced by 8½x11-in. sketch cards. These cards are used in the field for the plotting of the subsurface structures, etc., and are then forwarded to the office where they are properly colored and inked in by the drafting force, thus making these cards the office record, which does away with the work formerly involved in plotting the field notes from the book to the office card record.—From 1913 Report of the Philadelphia Bureau of Highways.

Resurvey of Right-of-Way: Wheeling & Lake Erie R.R.

A class of work which has been undertaken by several railways in recent years is that of resurveying and marking the right-of-way and other land owned, in order to have exact location and record of such property. The importance of such work is readily appreciated when it is realized that original records are often incomplete or faulty. As property both in the cities and along the railways increases in value it is increasingly necessary for the railways to define and assert their ownership by setting fences and monuments and recording all deeds and other transactions as to real estate.

Work of this kind has been carried out on the Wheeling & Lake Erie R.R., under the direction of W. L. Rohlock, Chief Engineer. The work of making the surveys and preparing the right-of-way maps covered a period of about five years for the entire system, involving about 500 miles of main line and branches. The cost of this, including all survey work and drafting, was about $60 per mile.


CANAAN TW'P.
CRESTON VILLAGE
Corporation Line
N
0' 100' 200' 300'
W.J.Smith et ux to Catherine A.Cook Nov. 20, 1877 Vol. 98 P.542
Right-of-way Line
Farm Crossing
18" Vit. Pipe
Side Track
Main Track
12" Vit.
Wm. M. Cook et ux. to W. & L.E.R.R.Co. Oct. 11, 1882 R. of W. Deed $400 Vol. 109 Page 55
Zenas Z. Crane et ux. to W. & L.E.R.R.Co. Sept. 4, 1874 W.D. $60 Vol. 109 Page 4
D= 2°00
Δ= 56°25'
T= 1576.98
L= 2321.25
E= 386.22
Eng. News

Portion of Map of Resurvey of Right-of-Way; Wheeling & Lake Erie R.R.
(Original scale 100 ft. per inch.)

A reduced example of a portion of one of the sheets of the right-of-way map is shown in the accompanying cut. The sheets are 18x42 in. over all, and 16x39 in. within the border, a 2-in. margin at the left end allowing sufficient room for binding. These plans are all made on a scale of 1 in. to 100 ft., except that the extra sheets showing the right-of-way through thickly settled cities or villages are on a scale of 1 in. to 50 ft.

On the tracings, the original center line as relocated by surveys is shown in a full red line; and the main track, where not coincident with this center line, is shown in black. Where the track is on or near the center line, only the red line is shown. All company sidings, private tracks, street lines and outlines of allotments are shown in full black lines. Sublot lines and figures representing the numbers of sublots (as taken from recorded maps) are shown in blue. Measured distances and figures representing controlling dimensions given in deeds, etc., are shown in black. The outline of the railway company's property is shown by broken lines (dash and double dot); fences are shown by broken lines, with alternate dash and cross.

Figures inclosed in circles designate the various parcels of land referred to in the property title notes on each sheet. Alignment figures are shown in red. Points where iron rail monuments are set are shown by red spots. Different tints indicate ownership as follows: (1) land acquired by deed, right-of-way contract or agreement; (2) land acquired by condemnation or act of public officials; (3) land acquired by lease; (4) land held in trust by agents or trust company; (5) land sold, or leased indefinitely. The explanation of this coloring scheme is shown on each sheet.

On account of the stationing on the road starting from the west end (at Toledo) and running toward the east, the maps are all made to read from left to right. Reference to this stationing is made along the right-of-way, being shown in white paint at intervals in conspicuous places such as telegraph poles, station buildings, etc., where the stationing may be easily picked up should it become necessary to tie into it when making additional surveys.

The original center line of the right-of-way is shown in all instances and where it does not coincide with the center line of the present track both the original center line and the track center line are shown. The fences along the right-of-way are not shown except where they do not coincide with the established right-of-way lines. Right-of-way posts are set at places where fences would not be desirable. These posts are 6 ft. long and project 3 ft. above the ground, the portion projecting out of the ground being turned to a diameter of about 6 in. The post is painted white and the lettering runs perpendicularly, showing it to be a right-of-way post of the W. & L. E. R.R.

One of the handy features of these maps lies in the references given to the original purchase of right-of-way. These are numbered consecutively through the different counties, the right-of-way books being divided into the several different counties along the line. The references show the date of the original purchase, the name of the original owner, price paid for the right-of-way and general conditions of the purchase. On sheets involving considerable detail as to streets and other data, where these references cannot be shown, the number of the references is simply shown on the parcel and a separate sheet is made up giving the details as above described. Examples of these references on the maps are as follows:

9. W. & L. E. R.R. Co. to N. Y., P. & O. R.R. Co. Apr. 15, 1883. Lease. $1. Given for term of 99 years and renewable forever on similar terms without further addition to the consideration above mentioned. To be used for railway purposes only. W. & L. E. R.R. Co. to defend the N. Y., P. & O. R.R.

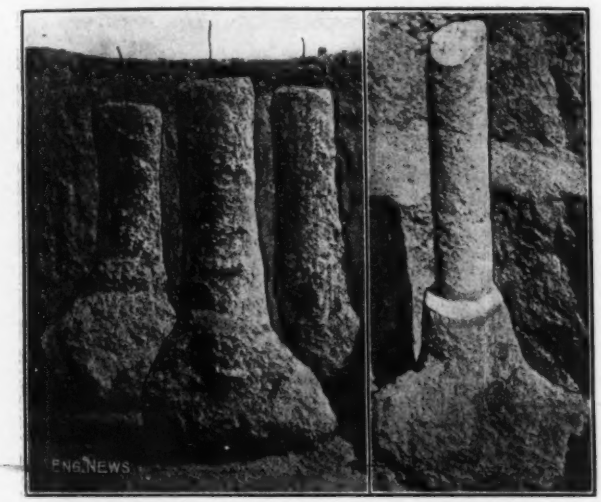
Co. in the enjoyment and peaceable possession of the premises. Part shaded in (green)covered by this lease.

10. A. L. Miner to W. & L. E. R.R. Co. Mar. 3, 1874. Right-of-way contract and $300 in company stock. Lease. Record, Vol. 1, page 577-8. A. L. Miner agrees to convey land if railway is built not later than two years from this date. Also railway company to have enough land in addition to the 66-ft. strip named to maintain proper slopes, and after location of said road the railway company may cut down trees that are liable to interfere.

12. Wm. M. Cook et ux. to W. & L. E. R.R. Co., Oct. 11, 1882. Right-of-way deed. $400. Vol. 109, page 55.

Concrete Piles with Bulbous Ends Formed by Explosive

The formation of enlarged or bulbous ends for concrete piles cast in place, in order to serve as footings and give increased bearing, has been employed in a number of cases, and a process of forming the cavity for the bulbous end by means of explosives has been invented in



CONCRETE PILES WITH ENLARGED BASES FORMED BY EXPLODING CHARGES AT THE BOTTOM OF THE HOLES

Europe, which is known as the Wilhelmi system. A wooden pile inclosed in a 16 or 20-in. steel tube is first driven, and is then withdrawn, leaving the tube in place. The explosive charge is then lowered in a shell or casing so made that the force of the explosion will be directed mainly in a lateral direction. The hole is then partly filled with concrete and the tube drawn up about 4 ft., after which the charge is fired and the wet concrete settles into the cavity thus formed. Fresh concrete is at once deposited until the hole is filled, the tube being drawn up at the same time.

This process has been used for supporting the pivot of a locomotive turntable at Havre, France, the foundation being a circular block of reinforced-concrete 45 in. diameter and 16 in. thick, supported by a single central pile 16 in. diameter. The point of the wood pile penetrated to a depth of 22½ ft. and the bottom of the steel tube to 21½ ft. A charge of about 1 lb. of explosive was placed and the hole filled for about 16 ft. with concrete, which dropped nearly 13 ft. after the explosion. As the additional concrete was filled in and the tube withdrawn, the concrete was tamped with a 220-lb. ram, spreading it into the compressible earth. The enlarged head was loaded with 40 tons of rails which remained in place for three weeks without causing settlement.

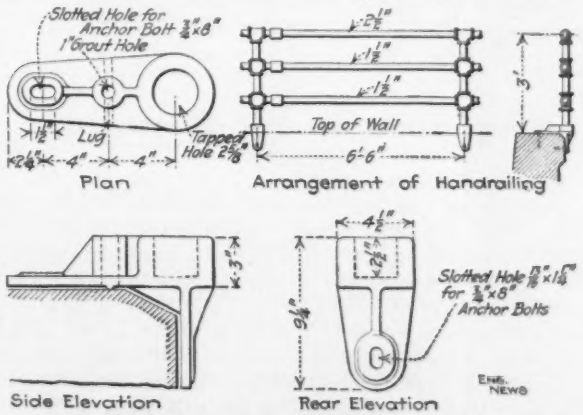
It is stated that in soft or loose soil the practice is to sink several piles close together. The French patents are owned by Camus, Besse & Drieux, of Havre, France. Our information is taken from an article in the June number of "The Railway Engineer," of London, from which also the accompanying illustration is taken. The same (or a similar) system, but under a different name, was noted in our issue of Aug. 21, 1913.

Hand-Railing for Bridges and Retaining-Walls

Where hand-railings are placed on railway bridges and retaining-walls it is desirable to place them near the outer edge of the bridge or wall, in order to give as much clearance as possible between cars and the railings. In some cases the railings are inclined outward to enable a man to lean back out of the way of a passing train.

On concrete walls and parapets it is very general practice to set the posts or standards of the railing at approximately the center line, but in the track-elevation work at Memphis, Tenn., the railings are placed along the outer edges of the retaining-walls and the shallow curb or parapet walls of the bridges. This is done by means of angle-shaped sockets fitted to the edges of the wall, as shown in the accompanying cut. This cut represents the railing on the South Front St. subway of the Illinois Central R.R.; in some other cases the posts or standards are 6 ft. apart.

The socket has a threaded hole for the pipe standard, a grouting hole, and two holes for anchor bolts, while a rib across the bottom leaves a ¼-in. grouting space between the casting and the masonry. The top of the railing is lined up to a straight line by rocking the castings on these lugs and tightening and loosening the bolts as



HAND RAILING SET ON EDGE OF RETAINING-WALLS ON TRACK ELEVATION WORK AT MEMPHIS, TENN.

required. When the railing is in line, the castings are grouted to a permanent bearing. The anchor bolts are leaded in place.

A Gyroscopic Monotrack Automobile has recently been demonstrated in London. This car has two wheels placed centrally in line in the chassis, while in the center of the chassis, below the seat, is the gyroscope, which is electrically driven. The speed of the gyroscope is 1200 r.p.m.

An Ash Wagon with Electric Hoist

For removing ashes from isolated power plants the Union Electric Light & Power Co., of St. Louis, Mo., operates ash wagons equipped with electric hoists to raise the ash buckets through manholes in the sidewalks. During the winter about six teams are in service, each hauling five loads daily. One of these wagons is shown in the accompanying cut.

ASH WAGON WITH ELECTRIC HOIST

The hoisting apparatus consists of a ½-hp. motor driving a small drum. The motor runs continuously and is connected to the drum by a loose belt, there being a belt tightener which is operated by hand when it is desired to hoist the bucket. Power is obtained through an extension cord connected to a lamp socket in the buildings. The motor, starting box, drum and belt tightener are all assembled on an iron bedplate supported by four spiral springs, and located at the rear of the wagon, as shown. There is also a davit fastened to the side of the wagon, with a pulley extending over the sidewalk to drop the bucket through the hole to the basement.

One man on the wagon operates the hoist and handles the bucket, another man being below for loading the buckets. A light wire rope is used for hoisting. The buckets are small, being only about 16-in. diameter, this being necessary on account of the small holes in the sidewalk. For information as to these wagons we are indebted to John Hunter, Chief Engineer of Power Plants of the above company.

Organization for Surfacing Track*

Prior to a job of surfacing track the first thing to consider is the widening of banks where the subgrade is too narrow to hold the ballast. The widening can be done to advantage with material excavated in widening cuts. The next thing is to decide on the uniform raise to be given the track, and the raise to be made in sags (if any). This being settled, the engineer should mark the grade stakes (in vertical figures) near the top to show the raise in inches. The figures should be on both sides (and not on the face), so that the conductor of a gravel train from either direction can see the figures. The station number can be marked on the back of the stake. This arrangement will assist the roadmaster and work-train conductor in getting the material distributed properly.

Where track is to be raised more than 12 in., any short sags should be taken care of first, and the track given one lift with the first lot of ballast to make room for sufficient material to finish surfacing on the second lift. Doing this work first avoids the necessity of hauling gravel over track where the surfacing crew is at work. The unloading and distributing of gravel should be under the personal direction of the roadmaster or an experienced foreman, and not left entirely to the work-train conductor. In this way the work can be supervised and markers set up to indicate where additional material is to be deposited by the next train.

I recommend the following organization for surfacing gangs varying from 50 to 100 men: One foreman, two assistant foremen and one timekeeper. One assistant foreman to do the raising, and the other to do the lining or to herd the men who are doing the tamping, as the work may require. The crew should be provided with six track jacks, two level boards, and two spot boards. One man should have charge of setting up the spot boards. A sufficient number of men should be kept ahead to dig jack holes, which should always be dug level so as to guard against throwing the track out of line.

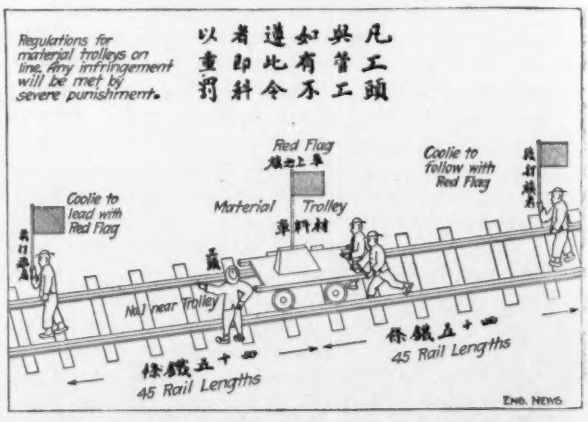
When raising track with 100 men, four jacks should be used (two on each side), and both sides raised at the same time. No men should be allowed to work ahead of the man who is sighting the track, so as not to interfere with his work in sighting the spot boards.

Wherever there are grades, the work should progress against the grade if possible. This will assist materially in holding the steel from running down grade. The foreman should see that the assistant foreman doing the raising makes a good run-off at the close of each day, so that it will not be necessary for trains to reduce speed at night. For eight gangs of tampers, two on each side and four in the center, the foreman should pick out eight of his best men and make these the leaders. Two tampers on each side and four in the center should go ahead, and tamp one tie and skip three ties and so on all day. The second and third gangs will tamp the next ties, and the fourth gang tamps the fourth tie, thus finishing the tamping in full. The center tampers do the same as the outside tampers, thus finishing up as they move along in organized form. The number of gangs may be reduced to three or increased to five, according to requirements.

*Condensed from an article in the June "Bulletin" of the Roadmasters and Maintenance of Way Association by J. O'Connor, Special Roadmaster, Minneapolis, St. Paul & Sault Ste. Marie Ry., Minneapolis, Minn.

Instruction Diagram for Trackmen on a Chinese Railway

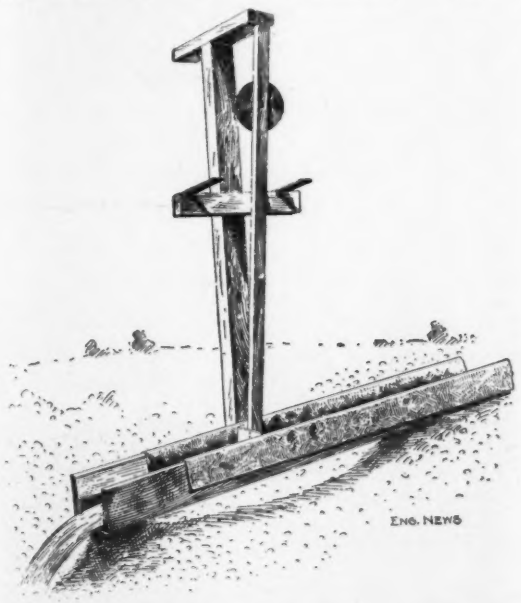
An example of the instruction diagrams issued to Chinese section foremen on the Shanghai & Nanking Ry. is shown in the accompanying cut. It indicates that in handling material on a push car there must be a red flag on the car, while other red flags are to be carried by coolie section-men 45 rail lengths in advance and in rear of the car. The foremen must stay near the car. Any infringement of the regulations "will be met by severe punishment." The cut is reproduced from an article in *The Engineer*, of London, May 22.



The railway is 193 miles long, with a 10-mile branch to Woosung, and is double-track for 54 miles. The track is laid with 36-ft. 85-lb. T-rails of the British standard section; the ties are of jarrah wood, 10x5 in., 9 ft. long, with 14 ties to a 36-ft. rail length. The line is well ballasted throughout. There is one tunnel 1320 ft. long built for a double line 28 ft. 3 in. wide at spring of arch and 27 ft. 3 in. at rail level, the height being 21 ft. 3 in. from rail to soffit. The line was opened in 1908. A. C. Clear is Resident Engineer.

A Field-made Pendulum to Indicate Pump Discharge

The accompanying illustration is from a photograph taken on one of the contracts of the Passaic Valley Sewer near Newark, N. J. It shows how a light 1x2-in. stick suspended from a frame as a pendulum, with its lower



FIELD-MADE PENDULUM TO INDICATE PUMP DISCHARGE

end in the flume of a pump discharge, indicates by its oscillation how the pump is working.

A steam vacuum pump is used to keep the water out of the excavation, discharging through about 150 ft. of rough wooden flume. About 30 ft. from the end a gallows-frame of 2x6-in. and 2x4-in. timber, about 6 ft. high, is erected at one side of the flume. From the head of this frame, hanging by a screw-eye over a nail, is a 1x2-in. stick about 6 ft. long. At the bottom of the stick a piece of rubber belting is nailed to form a paddle and to offer a larger surface to the stream of water. A round sheet of tin, about 8 in. in diameter and cut out of the top of a tin can, is nailed to the stick to form a target, and a little horizontal piece is attached to the standard about halfway up to form a guide so that the pendulum will not swing too far out of line.

The surge of the stream not only keeps the pendulum at an angle but continually agitates it through an arc of 10 deg. or 15 deg. By glancing at the indicator, the foreman, several hundred feet away, can always tell approximately how the pump is operating.

Instructions to Civil Engineers of the Southern Pacific Co.

For the benefit of the hundreds of young men just starting their careers as railway civil engineers, and for other engineers who wish to have a little insight into the duties of railway field engineers, we reprint the newly revised instructions of William Hood, Chief Engineer of the Southern Pacific Co., to chiefs of party and transitmen:

INSTRUCTIONS TO ENGINEERS IN CHARGE OF FIELD PARTIES

(1) All pay-rolls and vouchers are to be made out on the first day of each month, on the blanks furnished for that purpose, and forwarded to the Chief Engineer.

Give the Christian name and initial letter of a middle name on payment roll and voucher.

Itemize all vouchers, giving the date and place of disbursement; and when possible to do so, take receipt for all disbursements.

Time will be computed by calendar months and fractions of the same. A contribution of 50c. per month for hospital department will be collected by deduction on pay-roll from all officers and employees of the company, with the exception of Chinese, and those specially excluded from benefits. This contribution will be due on entering the company's service, and thereafter will be due for and apply to each month, or part of a month, while in the service.

(2) No time will be allowed men absent on private business. No time will be allowed any of the party, excepting those placed on duty by the chief of party until the work for which they were engaged shall commence; nor will any time be allowed after the evening of the last day's work, excepting to those detailed as teamsters, cooks, or for other duty by the chief of party or his agent. Give to men discharged a certificate of the time and amount due them.

(3) All men will be returned free to the place at which they were engaged for any particular survey—excepting by agreement to the contrary—unless discharged for disobedience or incompetency, or leaving without the full consent of the chief of party, in which case traveling expenses will not be allowed. Ten days' notice will be required from all employees, in order to leave the service in good standing, unless the requirement be waived by the engineer in charge.

In case of sickness of any member of party entitled to hospital treatment, the chief of party must give a hospital certificate.

(4) Books, stationery, instruments and other property of the company are to be kept in good order; the chief of the party will be charged for the same, and he must return them in like order in which they were received, or satisfactorily account for their damage or loss.

(5) All requisitions must be sent to the Chief Engineer by letter and the telegraph is not to be used for that purpose, unless writing would occasion delay or loss.

(6) Note on first page of every field book a full description of the particular route, line and work to which the notes relate, and enter date of each day's work in the proper place.

(7) Note name and address in each transit book of all members of the party; and in the level book, name and address of leveler and rodman.

(8) A journal must be kept, fully describing each day's work, and noting all information of interest, and how it was derived.

(9) Monthly reports must be sent to the Chief Engineer on the first day of each month, giving the lengths and descriptions of the various lines run and all work done, with such other information as may come within the knowledge of the engineer in charge, of which the Chief Engineer should be informed.

INSTRUCTIONS TO TRANSITMEN

(1) See that transit plummet and line are well protected from air currents, while being adjusted to the angle point.

(2) No instrument station must be in such a position as to prevent the line of sights for backsights or foresights striking within 2 in. or less of the point of the rod.

(3) Double-center all instrument points, checking each sight back, after setting the point on foresight.

(4) No sights are allowed longer than 1000 ft. on tangents, or 800 ft., or 45° deflection, on curves.

(5) On taper curves, the B.C. or E.C. and C.C.'s of main curve must be put in from each other by one deflection and long chord, and not through the intermediate compound curve points.

(6) Check all angles by magnetic bearings of all courses, and take true meridian at least once in ten miles, where practicable, in mountainous country, and once in 20 to 50 miles in open plains.

(7) A copy of alignment notes will be made out each evening on a traverse sheet, showing true (or assumed) bearings, and magnetic bearings, for use in mapping and for ready detection of errors in notes.

(8) All lines in mountainous country will be run with a 50-ft. chain. In open country a 100-ft. chain may be used on the tangents, and a 50-ft. chain on all curves.

(9) On location lines, small pegs must be driven to the ground surface at each chain length, as well as the usual stakes. On preliminary lines, stakes only need be used, except at instrument points.

(10) Stakes must be well driven and fit to stand several years.

(11) Chainmen will use hand levels to determine the difference of height of the ends of the chain, and will use plummets on all rough ground. Chain must be stretched out nearly in line on rough ground, before measuring the short successive distances, so as to use all parts of the chain instead of using one part repeatedly.

(12) All instrument stations put in at other points than at end of full chain must be measured in with steel tape and checked by chain. Where an instrument station is set at other point than at end of full chain, the next full chain station must be measured from the last one back of the instrument, and not from the instrument point.

(13) Chain must be tested once a day at least.

(14) All transit books must be paged and fully indexed.

WILLIAM HOOD,
Chief Engineer.

A Hand-Power Piledriver

The piledriver shown in the accompanying sketch is one built by the Chicago Tunnel Co. It was used on work at 12th St. and Wabash Ave., Chicago, to drive 4-in. pipe down 45 ft. to meet the section of the tunnel in service under 12th St. While this driver was designed to drive pipe, there is no reason why it should not operate successfully on light sheet piling.

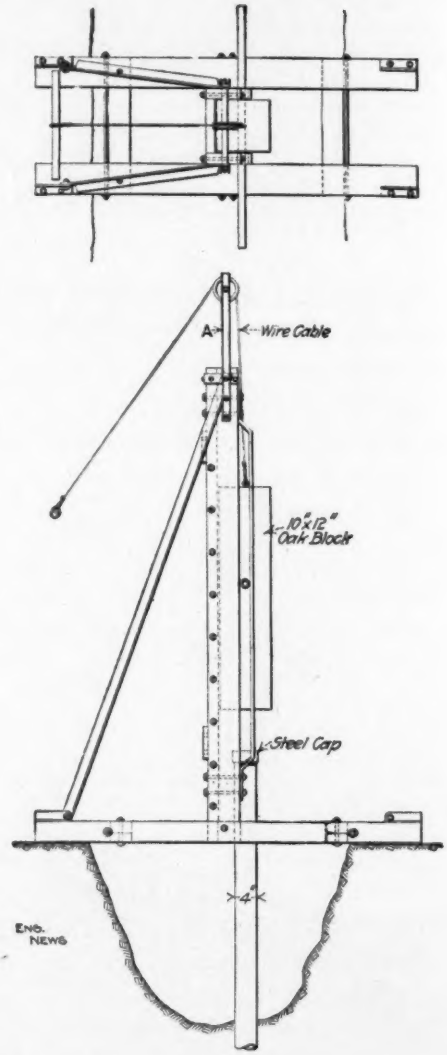
The driver itself consists essentially of a channel lead *A*, built by bolting two 2x6-in. sticks to each edge of a 2x12. This lead, about 6 ft. high, is supported vertically on a pair of heavy horizontal skids, approximately 4x6 in., and is braced back on to the horizontal skids by a pair of steel angles. The actual driving is effected by a 10x12-in. oak block, 42 in. long, sliding in the lead.

The driver is operated by four men: two stand behind the driver and with a pick handle looped into a cable, raise the block; the other two, standing each side of the block, working with a piece of pipe put through a hole in the block, bring the block down on the pipe being driven. The well timed effort of each pair causes the rig to deliver about 48 blows per minute.

To keep the block from going outward, a pair of guides is fastened to the face of the lead. The pipe-handle slides inside the guides.

On the work in question, 4-in. pipe was being driven in 8-ft. sections. A soft-steel cap screwed into the end of the pipe took the impact of the blows. Short sections, 2 ft. long, and follow blocks were used to get the pipe down. Accuracy of driving is shown by the fact that on this work 45 ft. of 4-in. pipe was driven down so as to meet a 12x12-in. opening cut in the roof of the tunnel.

The daily cost of operation, on this particular job, comprises the time of four men at $2.80 each and one foreman at $4, working 10 hr. Only one day was needed to get the pipe down. This included taking up a stone-block pavement over an area of about 6x6 ft., and excavating a hole about 8 ft. deep, with an average cross-section of 4x4 ft. The men started actual driving about 11 a.m. and the pipe was through at 6 p.m.



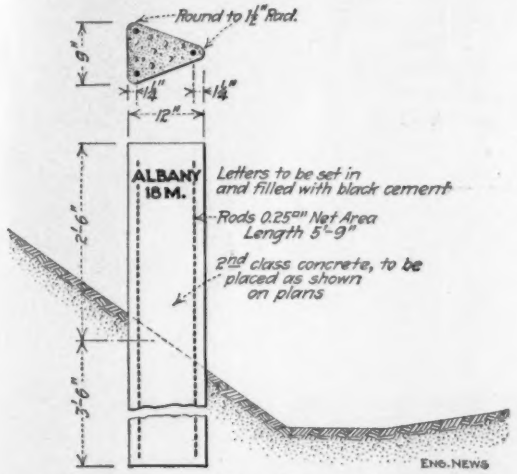
HAND-POWER PILEDRIVER

For this information we are indebted to A. Slade, Chief Engineer, and F. W. Knowles, Assistant to the Chief Engineer, Chicago Tunnel Co.

NOTES

Calculation of End Areas for Earthwork—H. A. Dawley, Louisville, Ky., calls our attention to the fact that substantially the same method of computing end areas as that described by W. L. Wells in our issue of June 11, p. 1303, was proposed by him in "Engineering News," Feb. 2, 1905, p. 126. On looking back we find this to be so, but Mr. Wells has described the process in more detail, and shows how the method may be applied to any cross-section. Originality for schemes in earthwork computation is a difficult claim to prove, as any one may determine for himself, if he will look through the files of "Engineering News" for the past 10 or 12 years; for no matter how much original research one may put into the subject, the subject itself has been explored so thoroughly that there is hardly a possibility of finding a single sprig of recent growth in the whole field.

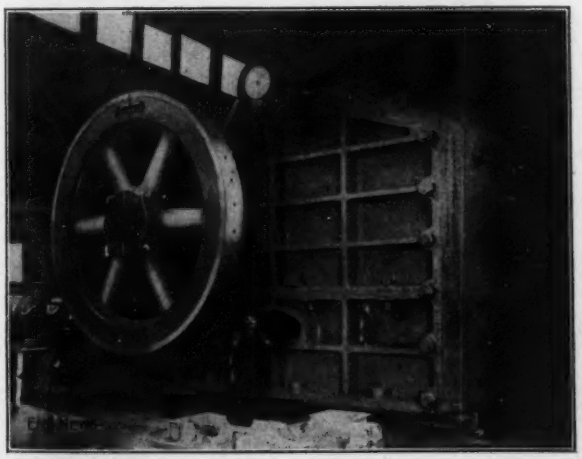
Reinforced-Concrete Mile Post—The accompanying illustration shows the standard reinforced-concrete mile post adopted by the New York State Highway Department. Each post contains about 1⅓ cu.ft. of concrete, so taking the cost of concrete at $10 per cu.yd. we have $0.55 per post, as an approximate estimate of the cost, exclusive of the rods and of the inscription.



STANDARD CONCRETE MILE POST, NEW YORK STATE HIGHWAYS

Very Large Rock Crusher—The accompanying view shows an all-steel frame jaw rock crusher with a 60x84-in. opening for breaking up rock to be used in the manufacture of asbestos.

The side plates are of rib design and were cast in two parts. The end plates are one piece. The crusher will be 19 ft. 7⅛ in. long, 11 ft. high and 18 ft. 1⅛ in. wide, and will weigh 500,000 lb. The machine is made of cast steel through-



A 60x84-IN., ALL-STEEL FRAME JAW ROCK CRUSHER

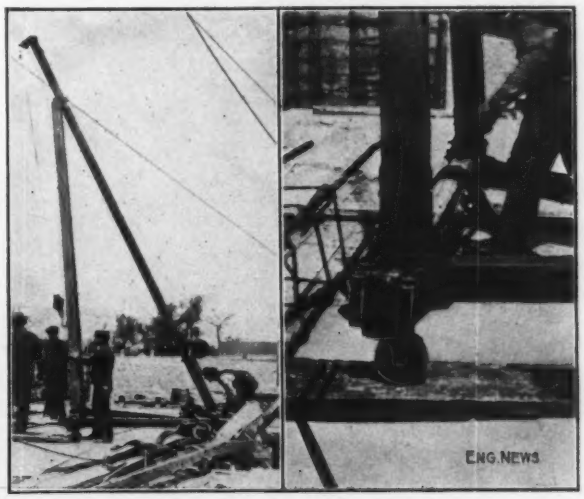
out, with manganese-steel crushing plates, cheek plates and toggle seats. A better idea of the size of some of the working parts can be obtained perhaps from their dimensions, notably those of the shafts. The main shaft is 23 in. in diameter, and the swing-jaw shaft 19 in.

What was primarily here desired was ample size of opening, in order to permit a reduction in quarrying expense. The size of the feed opening is 60x84 in., and under working conditions the crusher will deliver a 10-in. product. As an indication of its capacity, when crushing down to 14 in., it will crush approximately 1000 tons per hour. When crushing to 10 in., its capacity with asbestos rock is expected to be 3000 tons per 8-hr. day.

This crusher was built by the Traylor Engineering & Manufacturing Co., Allentown, Penn., for the Asbestos, Que., plant of the H. W. Johns-Manville Co., and cost about $25,000.

A Portable Cantilever A Frame Derrick—Handling construction units in concrete work is an interesting problem. Reinforcing rods are fabricated into bulky units, more or less rigid (usually less), and these frames have to be placed in the form; the "how" is often hard to find, at least with due regard to low cost.

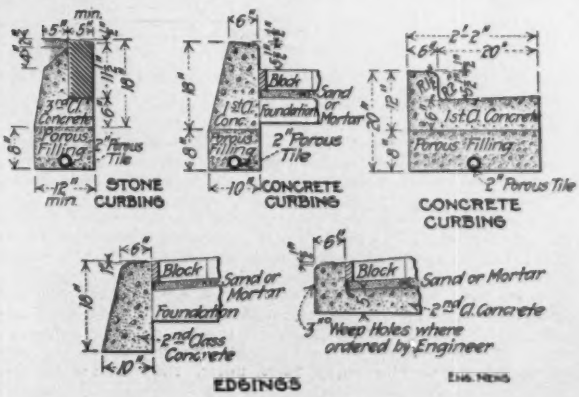
On work for the Excelsior Motor Co., Wells Brothers, Chicago contractors, built a cantilever tripod derrick rolling on heavy truck-casters and equipped with a hand winch. The frame was made of 6x6 timbers. The base is an equilateral triangle some 8 ft. on a side. The head block is about 20 ft. above the floor level. This derrick, set on plank runs laid on the floor forms, was used for elevating and placing fabricated frames of steel reinforcement in the heavy wall panels. Two views are shown herewith.



A PORTABLE CANTILEVER A-FRAME DERRICK

In Unloading Stone from Cars for the sewage filter at Aberdeen, S. D., the work was done mainly by rigging up a block and tackle so that a drag scraper could be pulled lengthwise of the car. The scraper dumped at the end over a trap into small dump cars below, on a 24-in. gage track. About 175 carloads of crushed stone were required to make the filter bed, and the above arrangement reduced the cost of unloading and making stone into position by about 50% as compared with unloading by hand. This statement is made in a paper by W. G. Potter in a paper on this sewage disposal plant, read recently before the Western Society of Engineers.

Curbings and Edgings, New York State Highways—The accompanying illustrations are self-explanatory. They represent the latest practice of the New York State Highway Department. Curbings are placed on roads through villages, where the street is bordered with sidewalks. The edgings are necessary on brick or block-paved roads.

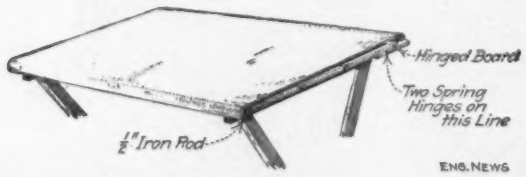


First Aid for Derailed Dump Cars—In handling heavy excavation work with steam shovel and dump cars, the impact of the earth, if it hits the dump car off center, is very apt to throw it off the track. To keep the work going properly, it is of course essential to keep cars on the track. On one of the contracts on the Sag Canal near Blue Island, Ill., where a 3½-yd. steam shovel is loading into 7 cu.yd. end dump cars, which are pulled up an incline, the car tender keeps a short piece of cable ready to hand at the loading point. At the first bump, when the car goes off the track, the tender jumps forward with the cable, gives it a sling around the front axle and a loop over the teeth of the dipper. A little signaling, construction "wig-wagging," some nice handling of the heavy boom and dipper, and the car is easily and quickly put back on the track. The contractors on the work where this kink was noted are Byrne Bros., Chicago.

LOOPING OF CABLE OVER DIPPER TEETH TO RESTORE DERAILED CAR

A STEAM-SHOVEL DIPPER BOOM FOR AIDING DERAILED DUMP CARS

A Spring-Roll Covering for a Drawing Table—The accompanying sketch shows the method employed for covering the drawing tables in the office of the Reinforced Concrete Co., St. Louis, Mo. Using a spring curtain roller is not especially novel. On the other hand, it is not universally in use in drafting rooms, although apparently the best method known. The novel feature of the present sketch is that the roll is mounted on a hinged board which can be swung back under the table and out of the way. Ordinary screen-door spring hinges are used. The bar in the end of the heavy, black oilcloth covering, which holds the covering smooth and close against the drawing board, is usually of ½-in. round steel.



ARRANGEMENT OF SPRING ROLLER AND OILCLOTH FOR COVERING DRAWING TABLES

A Graphical Determination of the Neutral Axis in a reinforced-concrete beam has been used for some years by Ernest McCullough, Consulting Engineer, Chicago. He believes it to be original with him. It is as follows:

In a singly reinforced rectangular beam, assume a ratio of deformation = 15, unit tensile stress in steel = 16,000 lb. per sq.in. and unit compressive stress in concrete = 650 lb. per sq.in. On squared paper (Fig. 1) draw a vertical line 10 units long; on the right at the top set off 15 units and on the left set off 1 unit, thus obtaining at ratio 1:15, the ratio between the moduli of elasticity, i.e., ratio of deformation. At the bottom of the vertical line set off to the left one unit and to the right 24.66 units, thus obtaining the ratio between the strengths of the materials, that is, $\frac{s}{e} = \frac{16{,}000}{650} = 1{:}24.66$. Connect the ends of the lines as shown. Then the vertical distance from the top to the intersection of the lines is the depth to the neutral axis of the beam, in per cent. of d, the depth to the center of the steel.

To find the percentage of steel: At b, Fig. 2, the shaded triangle is the total compression in the concrete, according to the straight-line formula. The maximum stress f_c is at the top and the area of the triangle $= \frac{f_c}{2} \times k$. The unit resisting moment $R_c = \frac{f_c}{2} \times k \times j$, in which j is the moment arm and is equal to $d - \frac{k}{3}$.

Then $R_c = \frac{f_c k j}{2} = 325 \times 0.38 \times 0.873 = 108$ (slide-rule used).

The steel ratio $p = \frac{R_c}{j f_s} = \frac{108}{0.873 \times 16{,}000} = 0.0077$.

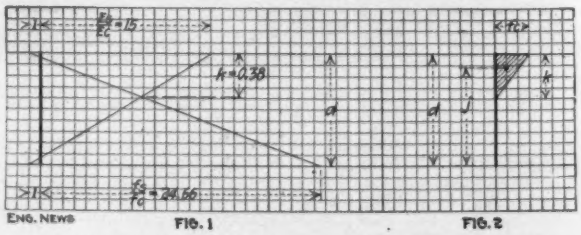


FIG. 1 FIG. 2

The foregoing method is easy to remember when one has forgotten the formulas for obtaining the value of k. It gives results as close as one may want, depending upon the size of the squares on the ruled paper. It is true for any strength ratio and any deformation ratio. It may also be used when the tensile strength and the compressive strength differ in a material, as in cast iron.

Editorials

Many strange tales have come out of East Aurora, New York—the home of Elbert Hubbard. Not the least strange and weird—to an engineer at least—is the following from the *Buffalo Express*:

East Aurora, June 23.—The problem of a sinking bridge is again before the village officers. Early this spring a new wooden bridge was built across a pond on the Gurdle Road, which leads directly through the quicksand beds in the northern section of the village. The new bridge has followed the trail of its predecessors, and is fast sinking into the pit that has already swallowed up 28 or 30 bridges in the last 50 years.

The sinking pond has a unique history. Originally, there was only a country sluice, with a four- or five-plank bridge to span it. Gradually it has increased in width, until now it takes nearly 300 ft. of planks to cross the black hole. The underlying formation is quicksand and the bridges slowly sink from sight. The new bridge, built less than three months ago, has been condemned by the highway commissioner, and the state department has been asked for a remedy to put a stop to the wholesale devouring of a bridge or two each season.

It seems to us that East Aurora displayed remarkable sagacity in turning to the State Department for advice. The recent experience of that department with treacherous quicksands should certainly have enriched it with a fund of experience to draw upon.

Engineers have some experience in dealing with ordinary quicksand, but a quicksand of such specific gravity that wooden structures and planks sink into it instead of floating on its surface is too diabolical and unprecedented for engineers to tackle. They will much prefer to have the experimenting on such quicksands done by diplomats. They may possibly be light enough to float.

Preventing Conflagrations by Rebuilding Congested Districts

The recent great fire in Salem teaches anew the same lesson which was taught by the conflagrations in Chelsea, in Baltimore and in half a dozen other cities during the past dozen years, to say nothing of the great Chicago fire. The lesson is that a large area of buildings of inflammable construction, closely huddled together, is a danger to other and more valuable sections of a city.

In certain foreign cities, the municipality itself has been empowered to tear down and rebuild whole areas, compensating the owners of private property for the damages; but we recall no case in which an American city has undertaken a similar sweeping reformation. In Cleveland, Ohio, however, through the fortunate circumstance of a railway condemning a considerable area for terminals, the city's most congested tenement district is to be partially abolished. The Cleveland & Youngstown Ry. Co., a new interurban line, has recently acquired property for terminals in this district and is tearing down over 130 buildings occupied by some 3000 persons.

When municipal authorities awake to the importance of city planning, such condemnation of districts which constitute a fire hazard to the rest of the city may become common. Under present laws, however, it would be exceedingly difficult for an American city to undertake such an enterprise.

The Approach Facilities of Large Railway Stations

A feature of railway station design which seems rarely to be given the attention its importance demands is that of the approach facilities for passengers. The track layout, the trainshed plan and the conveniences inside the station building are carefully studied. The architects lavish artistic ability on the ornamentation of the structure but the arrangement of street approaches with a view to the comfort and safety of arriving and departing passengers appears to be very largely neglected. A recent controversy between municipal and railway authorities over the plans for a new station was based largely upon complaint as to the inadequate and inconvenient passenger approaches provided by the plans.

Because of this usual neglect, especial interest attaches to the excellent solution of the problem at the Pittsburgh passenger terminal of the Pittsburgh & Lake Erie R.R., illustrated in this issue. Here a passenger arriving or departing is under cover all the way from the train to the street car, nor does he have to cross a street crowded with traffic in order to take a car going in the direction he desires. The way in which this is done is simple enough—merely roofing over a short section of the street, and making a subway beneath it; but it is none the less deserving of careful study. In this case the tracks are below the street level, but where they are elevated the street shelter may form a bridge connection with the train floor of the station.

It will be evident that in order to carry out this desirable improvement, coöperation between the railway, the city authorities and the street railway company was necessary. This coöperation ought in theory to be easily obtained. In practice it appears to be very difficult.

We have in mind one of the most costly and well planned suburban railway terminals in this country, completed only a year ago. It would have been perfectly easy to have arranged sidings at the station where street cars could have received the passengers delivered by incoming trains. Special cars for this purpose have long been required. The city authorities, however, would not permit street-car tracks to cross a sidewalk, hence one may see daily the entire traffic on the city's main street blockaded while a crowd of passengers are boarding the cars.

At many stations in this country the passenger who takes a cab or omnibus is well provided for and protected from the weather; but similar protection for the street-car passengers, many times as numerous as those who take cabs, is very seldom provided.

Nor is the covered cab stand always to be found. At how many stations may be seen cabs standing at the curb

with passengers landing at an open sidewalk and standing in the rain, snow, or wind while they pay the drivers and collect their baggage! At one several-million-dollar station may be seen thrifty porters who have equipped themselves with umbrellas to meet these conditions and to encourage the grateful tip.

Many railway stations in this country are placed as close as possible to the street, but in foreign cities it is very general practice to put a large court or open space between the street and the station, even when (as in London or Paris) the land thus occupied is of high value. This is due in part, no doubt, to the much larger proportion of cab traffic, which could not well be accommodated at the curb without interfering with the stream of street traffic. At the station entrance, therefore, the railway company may build such covers and shelters as it desires, without interference by municipal authorities. In many cases, also, the vehicles may drive into or through the trainshed. One objection to this has been the consequent dirt and smell, but with the reduction in horse-drawn vehicles and the increase in motor vehicles this objection is becoming of less weight.

Where a passenger must walk all the way across a broad plaza to reach a street car, the distance of the station from the street is an objection. The proper method in such cases is to locate loops or sidings for the street cars close to the station where they can take on passengers without stopping traffic on the main street.

Ocean Traffic and Municipal Prosperity

A great deal has been said and written in the last dozen years concerning the great effect which the opening of the Panama Canal is expected to have on the growth of various cities, particularly in the South. Most extravagant expectations are entertained as to the stimulus to trade and traffic which will result from the opening of the canal and the impetus to the growth of various commercial cities and seaports which will result. The fact is, however, that even if the canal should carry as great a volume of traffic from the very start as its most sanguine promoters have claimed, there is little reason to believe that it will have any noticeable effect on the growth in wealth or population of any city or seaport either on the Atlantic, Pacific or Gulf coasts.

The idea that the opening of the Panama Canal will greatly develop the business and wealth and population of various seacoast cities is really part and parcel of the widespread fallacy that commerce is the great influence which upbuilds cities. We refer to commerce, of course, in the limited sense of transportation; not in the broader sense in which the term includes all industry. It is not strange that this fallacy should be widespread, especially in commercial circles; but engineers who study causes and effects should have a clearer idea of the situation.

The reason why this fallacy is so widespread is because up to comparatively recent times it was indeed commerce which determined the growth of cities. It is a most interesting chapter in history that traces the rise and fall of famous cities in Europe by the growth and decay of their commerce. It was her facilities for water-borne commerce that made the greatness of Venice; it was their commerce that built up the cities of Holland and in a more recent era the seaports of Great Britain. In our own country down to the middle of the 19th century there were many cities which grew large and wealthy solely by their commerce. Such New England cities as Portland and Salem and New Bedford and New London owed their early prosperity solely to the shipping which sought their harbors. But the revolutionary changes which have taken place in transportation have absolutely altered the influence of commerce upon city growth.

A remarkable illustration of this economic fact is furnished by the city of Galveston. As most of our readers will recall, the United States government some twenty years or more ago ordered a commission of engineers to report as to what port on the Gulf of Mexico could best be improved to serve as a shipping point for the products of the Southwest, so that they could reach deep-water transportation there at less cost than that involved in carrying them a long distance to ports on the Atlantic coast. This commission reported in favor of Galveston as the port to be improved; and the government has since expended large amounts to give Galveston a safe and commodious harbor suitable for deep-draft vessels.

As a result of this improvement, in connection with the development of the Southwest and the increased production of goods seeking a market from that section, the commerce of Galveston has grown by leaps and bounds and its foreign trade is now larger than that of any seaport of the United States, excepting only the port of New York. In the fiscal year of 1913 the total trade of Galveston amounted to $290,000,000, whereas previous to the improvement of the harbor its commerce was comparatively trifling.

If the commonly held ideas as to the effect of commerce on city growth and development were correct, then manifestly Galveston ought to have doubled, or trebled or quadrupled in population in the third of a century which has elapsed since the census of 1880, at which date traffic through the port of Galveston was comparatively trifling. Instead of this being the case, however, the growth of Galveston has been extremely small. It had in round numbers 22,000 population in 1880, and in 1910, although the second city in the country in its volume of foreign trade, its total population was only 37,000. Better proof that a great volume of commerce may have little or no effect upon a city's growth in population could hardly be asked for.

When one contrasts the difference between old-time methods of transportation and those in force at the present day, it is not difficult to see why commerce has so little effect upon a city's growth. In the days when wooden sailing ships came up to the wharves of Salem, bringing their cargo of tea and silks from China, there were great profits in the shipping business. Those old sailing vessels remained a long time in port and required expensive refitting in sails and rigging and food supplies after every voyage. A whole list of industries prospered at each port upon the ships that brought and took cargo from there. The buying and selling in connection with the goods brought and taken by the ships, moreover, were generally carried on at the port itself; and the opportunities for profit brought a large influx of people to seek their fortunes.

All these things have been revolutionized by modern machinery and modern commercial methods. Nowadays, a million dollars' worth of goods may pass through a sea-

port with very trifling toll paid to residents of the port, even in the employment of labor. A thousand bales of cotton, for example, may be bought by a firm in Houston or Fort Worth or New Orleans, or New York City. The cotton is shipped from some interior point to Galveston. The cars containing it run alongside a steamer which may be owned in Holland or Liverpool or Stockholm, a gang of colored stevedores transfers the cotton from the cars to the hold of the vessel and she steams away to her destination. The only toll which any resident of Galveston has obtained from this commerce was the wages paid to the stevedores.

In the handling of grain, the case is even more striking, for the carloads of grain discharge directly into the boot of an elevator and without the intervention of human muscle the grain is stowed in the ship's hold.

Another apt illustration may be found in the transfer between railway cars and lake steamers at the principal lake ports. Buffalo owed its early importance to its position as the western terminal of the Erie Canal and the eastern terminal of the Lake transportation lines. As recently as 20 years ago, the transfer from the vessel to the railway car gave employment to an army of shovelers in handling grain and ore and coal. But modern machinery has now dispensed with the shovelers. Today on some of the great ore docks on Lake Erie an operating force of only three men can move the entire cargo from a big lake ore steamer and place it in railway cars ready for shipment within half a dozen hours.

The same thing is illustrated at the head of Lake Superior where the ports of Duluth and Superior handle a traffic whose tonnage exceeds that of any other port in the world. This vast traffic is handled and transferred with only very trifling tribute to the two cities.

The city of New York 15 or 20 years ago was greatly exercised because its export traffic in grain was slipping away from it. The cost of handling grain through its crowded harbor, with the necessary expenses of lighterage, etc., was such that grain dealers began to send their shipments by preference through such ports as Baltimore, New Orleans, Galveston and Montreal, where the cars could be discharged directly into the ship alongside. It was agitation over this situation that led the State of New York to undertake the $100,000,000 barge canal from Albany to Buffalo so that New York's commercial supremacy should be maintained.

The theory of those whose influence brought about the undertaking of the New York Barge Canal enterprise was that New York City owed its growth and prosperity chiefly to its location at the terminus of the water route from Buffalo to tidewater by way of the Erie Canal. They held that unless the importance of this water route could be maintained by rebuilding the Erie Canal to make the new Barge Canal, New York would decline in population, prosperity and wealth compared with rival Atlantic seaports.

It is interesting now to recall some of the lugubrious prophecies concerning the decay of New York's commerce that were current fifteen years or more ago. The prophecies have indeed proved true in this respect, that the export grain traffic which formerly flowed through New York has been almost wholly diverted to other ports; but the prophesied effect upon the city's growth and prosperity is nowhere to be seen. Grass does not grow in New York's streets; and the chief problem of the city is not how to secure additional population, but how to provide transportation facilities for the vast numbers which every decade adds to its population. Traffic by Erie Canal boats has ceased to have any commercial significance whatever; the new Barge Canal is not completed, and no one in commercial circles betrays any particular interest as to when it will be completed.

In business circles it has now come to be recognized that with railway rates under public control, it is to the advantage of shippers and the public to have as much freight as possible handled by the railways, so that they can afford to handle it at the lowest rate, instead of trying to hamstring them by taking away a part of the traffic and carrying it at public expense on the water route. Enormous as is the volume of New York's commerce, it is after all only a trifling proportion of its enormous population that depends upon that commerce for a living. It is manufacturing industries, and not transportation, that engages the great bulk of its people.

Two other Atlantic Coast cities which have been recently greatly concerned over their commercial facilities are Philadelphia and Boston. Apparently, some of the Philadelphia commercial organizations believe that the future prosperity of the city depends upon the increase of its foreign trade. The absurdity of this is manifest enough when one compares Philadelphia, with its million and a half of population, and Galveston with its 30,000. Were Philadelphia to succeed in increasing its volume of foreign traffic so as to displace Galveston as the second city in the country in volume of foreign trade, it is probable that the resulting increase in its population would be too small for anyone to discern. Here again it is Philadelphia's great manufacturing establishments and not the vessels which enter and leave its harbor, that determine its prosperity.

We are, of course, by no means unmindful in this discussion, of the importance of proper transportation facilities to a city, and especially to a manufacturing city; but good railway facilities, enabling a manufacturer to place his product directly upon a car at the gate of his works, are many times as important to a city's welfare as are its facilities for water transportation, even though the city be located on the seacoast.

Further than this, it is important to bear in mind that improved transportation or transfer facilities at a seaport, are chiefly of benefit, not to the seaport itself, but to all the country which sends and receives products through that port. The cheap route from the Southwest to Europe through the port of Galveston, made possible by the millions expended by the Government in the improvement of Galveston Harbor, has benefited the producers of half a dozen Southwestern States vastly more than it has the City of Galveston itself. Improved facilities for ocean shipment at Boston benefit the State of Massachussetts, and all of New England and other sections which send commerce to that port, far more than they benefit Boston itself.

That the statements made above are well grounded, there is plenty of evidence, in addition to what we have cited above, to prove. These statements have a direct bearing upon the present tendency in numerous cities toward municipal extravagance in connection with transportation facilities. Suppose the City of Galveston 20 years ago had decided that it would itself undertake, at its own

expense, to carry out the work of harbor improvement, and the building of wharves, piers, etc. It can easily be imagined that in the days when the Southern real-estate boom was at its height twenty years or more ago, enthusiasts might have declared that by such a municipal expenditure that city might at no distant day become the second in the country in volume of its foreign trade. It would have been assumed as a matter of course that on reaching that proud position it would have experienced an enormous increase in population and in wealth. It is quite within the possibilities that had not a great calamity overwhelmed Galveston it might have embarked on some such financial venture, just as much larger cities on the Pacific and Atlantic and Gulf coasts are today embarking on large enterprises for the development of terminals for water-borne traffic.

We would not be understood by any means as wholly condemning such enterprises. We have indeed recognized the importance to a city and to its tributary territory of proper facilities for the conduct of land and water transportation. The point we would emphasize is that when a city undertakes such an enterprise it should do it on the same basis as a private investor; that is to say, it should plan to receive a liberal income on its investment from the rental of the privileges which it provides. It should not be deceived by the specious claim that the city can afford to provide such privileges at the expense of the taxpayers because of the indirect benefit that will accrue.

How widespread is the belief in these indirect benefits may be seen in New York City, where there is constant pressure upon the city authorities to reduce the rentals of docks owned by the city, below what will return to the city a fair income on their cost, on the plea that the city must do it because of the indirect benefit it receives on account of the commerce so provided. As we have remarked above, fallacies of this sort are widely held, by prominent men engaged in mercantile and manufacturing pursuits and by those who direct influential commercial organizations. It is the business of engineers, however, who carefully study questions of this sort, to hold correct views upon them, and be able to advise the public against unwise and unsafe expenditures.

Letters to the Editor

Longitudinal Expansion Joints in Brick Pavements

Sir—O. M. Severson, in a letter printed in ENGINEERING NEWS, of June 4, raises the question of the necessity for longitudinal expansion joints alongside the curb of brick pavements. He rightly dismisses transverse joints as useless. He might have gone further and said that transverse joints are a positive detriment to a pavement.

I cannot, however, subscribe to Mr. Severson's contention that the only use of a longitudinal expansion joint "of any value is to protect a flimsy curb." "A light curb," says Mr. Severson, "set only in a sandbed, may need the joint, but if the curb is properly built so as to be permanent, it will withstand the pushing due to the expansion of the pavement."

If the resistance of the curb were the only question involved, no issue would be raised. But, while I do not write in a controversial spirit and have no intention of entering upon a controversy, I desire to point to a few facts which Mr. Severson seems to have overlooked, and which, if duly considered, might modify his conclusions.

A curb that could be depended upon to withstand the extreme push of an expanding grouted-brick pavement could easily be built, but probably such a curb would add materially to the cost of construction. Allowing that an ordinary curb needs protection, a longitudinal expansion joint gives the protection at a minimum cost without impairing the structural integrity of the pavement itself. Therefore, the joint is justified by economical considerations.

Perhaps I do not define the term "flimsy curb" exactly as Mr. Severson means it to be understood. It seems hardly probable that he has in mind the standardized stone curb; yet I have seen a curb of that kind, a curb having a 4-in. dressed top, and set in 2 ft. of concrete, sheared off at the top and the concrete base heaved by the thrust of expansion in a pavement having transverse expansion joints but no expansion joints alongside the curbs.

This object lesson teaches the possibility, rather than the probability, of a well built standard curb failing to perform its duty; but the lesson has a value—it proves that in order to be absolutely sure that a curb will not yield to the thrust of expansion under any circumstances, it is necessary either to increase the strength of the curb, or buttress it with a sidewalk, or put in a longitudinal expansion joint. The problem of handling expansion is not merely a question of the stability of the curb.

If expansion cannot find relief at the curb, it must be equalized by compression or the pavement will bulge. If we take up the expansion by means of a longitudinal joint, we keep the brick in contact with the sand cushion beneath, thereby preventing the rumbling noise so often heard and usually caused either by the lifting of the pavement or by the sinking of the foundation.

The theoretical adequacy of compression to offset expansion is tenable, if at all, only in the case of a pavement lying perfectly flat and level. This type of pavement is never constructed. A crown is necessary for drainage, although the crown should be no higher than is absolutely necessary for drainage. We have in the crown a very different problem from that presented by a flat pavement.

Highway engineers know that a grout bond which fills only the upper interstitial space between bricks, leaving the lower space vacant, acts as a wedge against the buttress or haunch of the arch. This wedge intensifies the upward trend of the applied force, causing the crown of the pavement to strain.

If the thrust of expansion exceeds the ultimate strength of the arch to resist heaving, something must yield—

if not the curb, the pavement. If the thrust of expansion is greater than the resistance, plus the compressibility of the crowned pavement, the pavement will buckle. With only a curved pavement to relieve expansion, compensatory compression is practically a negligible quantity. Thus we have the basic theory of the necessity for an expansion joint along the curb, and generally speaking, engineers are agreed that the theory is sound.

I beg leave also to except to Mr. Severson's statement in substance, that concrete pavements and brick pavements are on a parity in respect of expansion and contraction, although I surmise he did not mean exactly that.

Both materials expand and contract, but not equally, and some authorities claim that both do not expand from the same cause. After expansion or contraction, brick resumes a normal state. Concrete acts differently. Brick is a finished product. After it is laid it undergoes no seasoning process that might cause changes in its density, molecular structure, chemical elements or proportions.

Concrete, being spread while very wet, is expanded by its excess of moisture content. A large percentage of the original moisture content is lost by evaporation during the process of hardening. What concrete gains in density through hardening, it loses in volume, and this shrinkage involves a pulling away of the mass from some original point of contact, or a fracture at some place in the mass. The point of cleavage may be at the curb, but usually longitudinal cracks appear either along the median line of the crown of the pavement or on either side of it, or both, and often it happens that radial cracks appear.

It is well to bear in mind that whether concrete be expanded by heat or by moisture, it never expands after hardening to the extent that wet concrete contracts in hardening. We have, therefore, in a concrete pavement, an initial contraction which never is completely overcome by subsequent expansion; for the reason that the moisture content of the concrete, when it is mixed, is never as great afterward.

The necessity for spreading concrete while it is wet and plastic explains the fact that a concrete pavement cannot be patched satisfactorily. A defective brick can be replaced by a good one; but a wet patch placed in hardened concrete shrinks in drying and pulls away from the adjacent pavement, leaving an interspace between patch and pavement which entirely surrounds the patch.

The crack may not define itself at once, but the line of cleavage is established at the outset of the hardening process, so that the appearance of the fracture is only a question of a short time. Even in the matter of cracks, a wide difference between brick and concrete exists.

A crack in a brick pavement is unsightly and undesirable, but it is not necessarily immediately harmful. Brick pavements often give excellent service for many years after cracks have appeared. Brick does not disintegrate, it wears away by abrasion. But when concrete cracks or pits, it begins immediately to ravel and the progress of disintegration goes on so rapidly that the pavement usually goes to the bad within a comparatively short time.

F. A. CHURCHILL,
Dunn Wire-Cut-Lug Brick Co.

Conneaut, Ohio, June 23, 1914.

A Warning to Railway Construction Engineers Working for English Companies

Sir—Recently a limited liability company organized under the laws of England to engage in railway construction in South America went into voluntary liquidation in England. About 30 engineers, who were employed in South America, were sent home and discharged. All of them were under three-year contracts and had completed about half of their time. A clause in their contracts stated that in case they were discharged the company would pay them six months salary. After reaching England, these men went to the Receivers of the company to get their pay and were informed that the company would only pay £50 to each man.

I am informed that according to English law when a company goes into voluntary liquidation, the salaries have preference up to £50 provided the arrears do not date more than four months back; but any salary accruing after date of the company going into liquidation and all expenses due to the employee and any balance of arrears over the £50 becomes an ordinary debt and is second to the bondholders' claims. The average engineer seems to be under the impression that salaries and wages are preferred claims, but it seems they are not in this case, according to English law.

The Chairman of the Board of Directors of the construction company is also the Chairman of the Board of Directors of the bank which owns all of the bonds.

All of the engineers have claims running from £150 to £1000 each and apparently they will only receive £50 apiece. These men are all capable and honest and the officials who were in charge of the work are also good men; but the bankers and lawyers of the company will find all of their doings looked upon with suspicion in the future.

It would be wise for men who have employment contracts under English law to insist on having their salaries paid at the end of every month.

M. E. R.

Rio Janeiro, Brazil,
June 4, 1914.

NOTES AND QUERIES

A correspondent asks if there is any record of cooling ponds built of reinforced concrete. We have no knowledge of such construction and would be glad to hear from any one who has. Useful information would be in regard to any concrete tank containing water of a temperature of say 200° F., with an outside temperature of 0° F.

The Liberalizing Tendencies of Good Roads Enthusiasm is illustrated by two news items of June 19; one is from Cañon City, Colo., stating that the bankers and business men of that municipality "realizing that brawn and muscle are essential to the construction of public highways, have not only subscribed liberally of money, but have gone out with pick and shovel and worked 10 hours a day to improve the roads"; the other item is from Jefferson City, Mo., and states that 40 convicts have been selected for experimental work on the public roads of Missouri. Convict labor is now authorized in practically all the states except Connecticut, Massachusetts, Rhode Island and Minnesota; yet in spite of this road work appears to be looked upon as a fashionable recreation by eminent citizens in many parts of the country.

The Recent Street Subsidences in Paris, France

Following a very severe rainstorm on June 15 the sewers and streets in the city of Paris, France, were flooded to such an extent that severe subsidence took place in three different locations near the center of the city and a number of minor depressions occurred all over the city area. At last accounts about 14 deaths were caused by the accident and it is thought that a number of others may have occurred, the bodies having been washed through the sewers to the Seine and not yet discovered, The cable reports which came first from Paris did not particularize the cause of the trouble, but recent advices seem to show that the subsidences were due primarily to the overflow of flooded sewers into subway excavation.

The city of Paris is now constructing by contract under municipal engineering direction a number of new rapid-transit subways. Owing to the very great complication of underground structures, both of a public-service nature and old building foundations, it has been considered impossible to drive these tunnels by the shield method. At the same time it appears that the Paris engineers are not acquainted with the cut-and-cover method now being so successfully employed in the construction of the New York subways, because it is stated that they cannot allow the stoppage to traffic incident to the open-cut subway construction method. There remains, therefore, only the timbering tunneling method.

The subways now under construction in and around the Place de L'Opera are being driven by the ordinary timbering method; that is, a center heading is first driven and arched up, side excavation being carried out by fan-shaped timbering on either side. Just at present a large part of the subway has the center arch in place, the masonry being supported at its haunches on the as yet unexcavated earth. Above the tunnel section the sewers and water mains of the city are allowed to remain in their normal position not many feet away from the crown of the subway arch.

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FIG. 1. CAVE-IN IN THE RUE DE LA BOETIE, PARIS, CAUSED BY SEWER OVERFLOW INTO SUBWAY WORKINGS

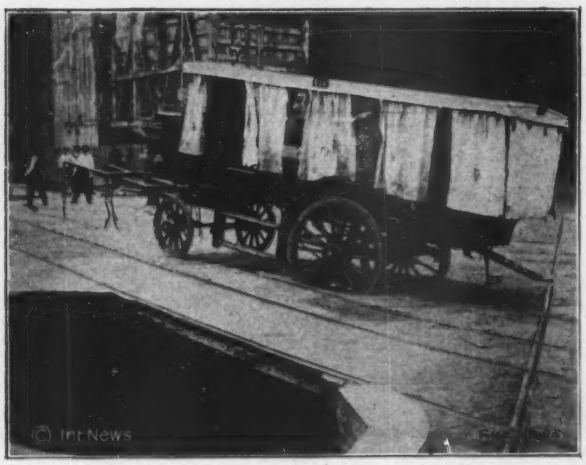

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FIG. 2. CAVE-IN BENEATH PLACE ST. AUGUSTIN

The rain of June 15 was very sudden, so sudden that it was not possible for the city authorities to control the turnout valves by which the excess rainfall flow is diverted from the sewers to the river. Consequently, the sewers soon became full and in places under pressure. It seems that they either began to leak or in places actually broke, allowing the full flood of the excess flow to be diverted onto the subway top where in three places, as noted above, the sides of the arch were undermined and the arch dropped, carrying with it the superposed earth, wire conduits, water and sewer pipes and street paving.

The accompanying views show two of the three large subsidences. Fig. 1 is on the Rue de la Boetie. At this

point it will be seen that the subsidence approached dangerously near the foundation of the adjoining building. Fig. 2 is in the Place St. Augustin. Here in the foreground is a large opening about 50 ft. long, 40 ft. wide and 33 ft. deep, roofed over by the wood-block paving shown. It was in this hole that a taxicab with a driver and woman passenger disappeared, and the man and woman were both drowned.

Report of the Board of Engineers on Flood Control in Los Angeles County, Calif.

In February of the present year the city and county of Los Angeles were visited by an exceedingly heavy rainfall which resulted in a record-breaking flood throughout the entire district. ENGINEERING NEWS in many numbers throughout the first half of this year reported various details of the damage done by the flood water. On Apr. 3, 1914, a committee was appointed to investigate the causes of the flood and to report upon a system of flood control which might be adopted. This committee consisted of H. Hawgood, Chairman, Chas. T. Leeds, J. B. Lippincott, Frank H. Olmstead and James W. Reagan. The provisional report of the Board of Engineers who constitute this committee was made on June 3, 1914. Below is given a brief abstract of the recommendations.

FLOOD DAMAGE

The committee first sought to compile a record of the flood damage and sent out a number of blanks from which estimates of damages have been made. The data returned to the Board up to June were as follows: Land overflowed, 11,763 acres land totally ruined, 1904 acres land partially ruined, 1081 acres. The estimated amount of losses in ranch and horticulture property is $2,626,845, which includes only about 60% of the loss of the county outside the city of Los Angeles, so that a total ranch or farm loss in the county would be about $4,476,000, to which should be added the losses of the private corporations operating in the county and county highway losses of $2,725,000. Besides this a loss of say $500,000 occurring in the city of Los Angeles may be added, making a total physical loss in the county of $7,601,000.

This amount is only for property or physical loss. In only a few instances were the losses incurred by way of depreciation in value of property included in the estimate. The committee finds that the sum of the depreciated losses and loss due to suspension of business fight total about $2,500,000, making the approximate cost of the floods of February about $10,000,000.

PAST FLOODS

It appears that there had been some heavy floods in the district in 1825, 1833, 1862, 1867, 1884, 1886 and 1889, the flood of 1889 being the heaviest, with perhaps the exception of that of 1862. Since 1889 there have been serious floods in 1891, 1906, 1911 and 1914. This covers a period of 90 years. The mean interval between destructive floods has been about eight years, the maximum interval twenty-nine years, and the minimum three years. Considering the expectancy of floods, it is to be noted that in five years, 1884 to 1889, there were three destructive floods, two of which, notably 1884 and 1889, being among the highest on record.

RECOMMENDATIONS

The Board's recommendations are as follows:

The methods available for flood control are broadly separable into two general classes, opposite in their action; first, those which accelerate the discharge of the main streams, such as the improvement and straightening of channels; second, those which retard and regulate the flow of the feeders into the main stream, such as dams, the spreading of water, the planting and preservation of trees, and especially of low growing brush and willows.

The methods that the Board is able at this time from the data before it to recommend are as follows:

The waterways should be of a type having a channel of moderate width and depth for low-water flow, with levees of such height and set out at such distances apart as would provide an adequate flood channel. The dimensions of the channel should be varied from place to place according to the hydraulic requirements. Protection can be effectually given the levees by revetments and by spur dikes of piles and wire netting. The well-known protection of fascines and mattresses of willow cannot be adopted except in a few places for the compelling reason that the country does not as yet afford a sufficient wealth of willows to supply the necessary material.

The top of the levees throughout their length should be prepared with particular regard to their use by heavy motor trucks. These roadways would be of great value for maintenance service and are in fact a necessity. In making the roadway, oil would be used. The Board is investigating the value of extending the oil into the water face of the levee to furnish resistance to erosion of the light soil, of which many of the levees must necessarily be built.

While flood control by levees in this and foreign countries has been marked by numerous failures and it is impossible to forsee conditions and meet every future contingency, it is a noticeable fact that these failures have been almost universally due either to undue encroachments on the river channel or to insufficient design, inspection and maintenance.

The spreading of flood waters over the gravel deposits and miles of cañons is in general advocated by this Board, it is believed it will indirectly repay in most cases the cost of work from increased irrigation and water-supply alone.

The Board is of the opinion that it may prove a very important factor in avoiding flood damage to construct, according to the Swiss practice, a series of low and inexpensive dams in the upper tributaries of the various watersheds. The effect of this is to change the naturally continuous slope of the stream bed to a succession of steps similar to the drops inserted in irrigation channels to reduce velocity. This method opens the way to vary the time and rate of the maximum flood discharge of the numerous feeders so that the waters from the upper watersheds shall not arrive at the cañon narrows at the same time as the water from the lower side cañon.

There then follows in the report detailed recommendations as to the treatment of the particular rivers which were flooded in the recent floods. The report concludes with the following general recommendation:

The Board recommends that only substantial construction be employed and whatever can be done to commence the work of flood control, even if it be at first only work on the smaller streams and the cleaning of obstructions to the larger, be put in hand with all possible speed. Surveys should be made to define the rights of way for the official channels and to base detail estimates of construction costs upon. All work, irrespective of size, should be approved and supervised by a control board or authority appointed by the county in order that they may be harmonized into one general plan by which means alone can success be achieved. No flood or storm water control, construction, or structure over official waterways should be permitted that is not in accordance with the adopted general plan and approved by this adequate authority.

The Board considers that the construction of the works noted in its report, together with a 25% overhead allowance and including $1,400,000 item for harbor work on six miles of Los Angeles River (which may be considered particularly a federal and state concern and which possibly would be undertaken by the state or the Federal government) would cost about $9,400,000.

A Pittsburgh Railway Station

By R. P. Forsberg*

SYNOPSIS—The most striking feature of the station entrances is the exceptional protection from the weather for those passing to and from the street cars at the station. There is the very unusual arrangement of a shelter roof over the street and sidewalks, with stairways and a subway under the street. The station has forced-draft ventilation, with the air washed and heated, or cooled to suit temperature conditions.

The Pittsburgh & Lake Erie R.R. terminal station and general office building at Pittsburgh, erected in 1900, is located on Smithfield St. at the south end of the bridge over the Monongahela River.

The facilities for caring for passengers arriving at and departing from the station have been enlarged at an expenditure of approximately $45,000, adding the feature of making it possible to pass under cover from train to street car or other conveyance. The general arrangement is shown in Fig. 1, and also by the plan, Fig. 2. The station has both stub and through tracks, and the level of the general waiting room and the concourse and platforms is 16 ft. below the street level. The plan, Fig. 2, represents two levels, but the notes and description will make its meaning clear.

Passengers arriving by train pass from the trainshed into the concourse. From this they may pass through the waiting room to reach automobile, cab, street car or sidewalk, or they may go by a more direct route to these same points, under the protection of a covered way outside of the station building but at the platform level, as shown.

The large majority of passengers do not pass through the waiting room, but use the covered way. From the end of this, the passengers may use the stairway to the street or pass through the subway to the east side of the street. The latter is the proper route for passengers taking northbound cars, as its use protects them from crossing at grade a street thickly congested by street-car and vehicle traffic. A "cornerman" is on duty at this crossing for the protection of pedestrians who fail (through choice or otherwise) to use the subway but cross the street and tracks at grade. A suitable booth with glass sides is provided for the "cornerman's" protection in severe weather.

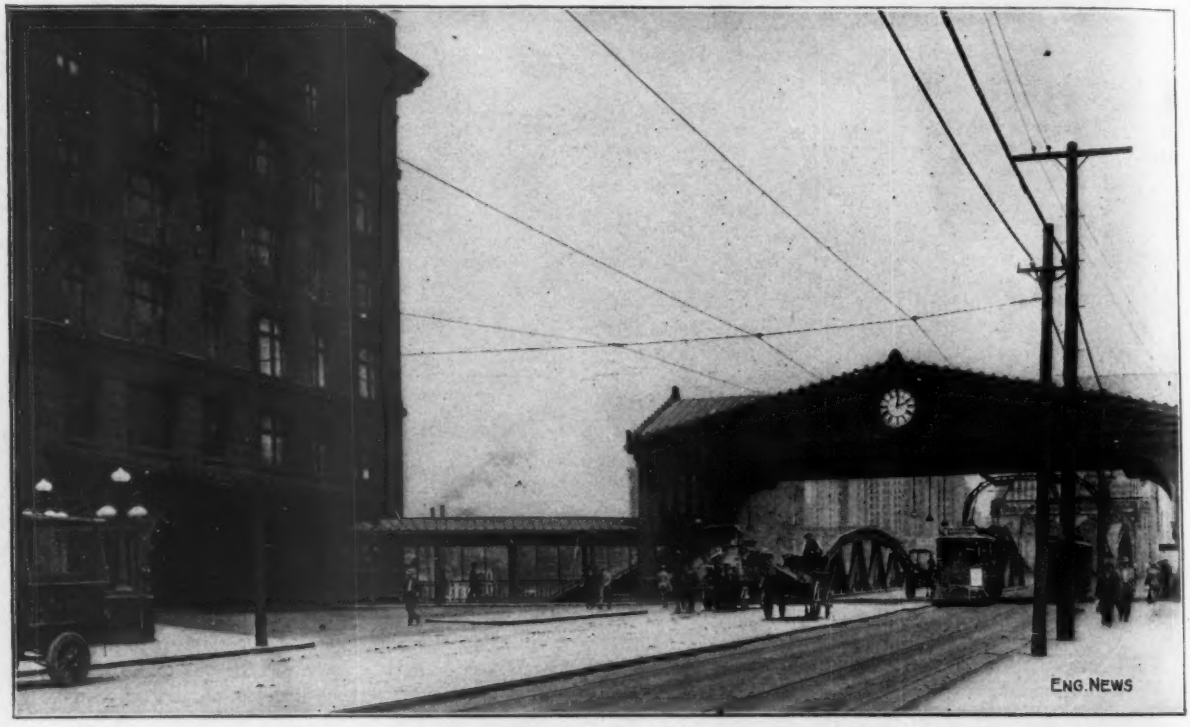


Fig. 1. Street Shelter and Covered Way at the Entrance of the Pittsburgh & Lake Erie R.R. Terminal Station; Pittsburgh, Pa.

The stand for taxicabs, automobiles and cabs, is directly under the Smithfield St. approach to the station, and passengers may reach this stand under cover. Signs are clearly displayed directing the route to be traveled at all points where there is a divergence of routes, so there need be no doubt or misunderstanding in the minds of strangers as to which route they should take.

Passengers arriving at the station to leave by train are afforded similar protection. If they arrive by street car, they alight under the protection of a roof 45 ft.

*Assistant Engineer, Pittsburgh & Lake Erie R.R., Pittsburgh, Penn.

wide, spanning the entire width of Smithfield St. (Figs. 1 and 3). These passengers should use the stairway on the east side of the street, leading down to the subway. From the west end of the subway they may go through the station, if they desire to purchase tickets, check baggage, etc., or, if all this has been arranged, they may go by the more direct covered way to the concourse.

Pedestrians from the north and parties alighting from the street cars who desire to reach the station by crossing Smithfield St. at grade (a bad practice) may either use the covered stairway that leads to the covered way to

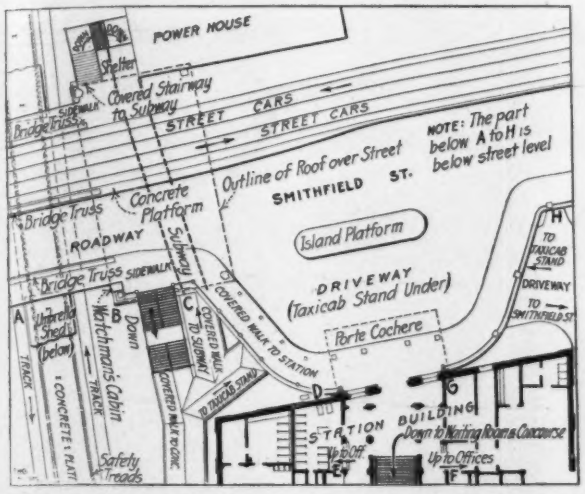


FIG. 2. PLAN OF STREET SHELTER, COVERED WAY AND SUBWAY FOR PASSENGERS; PITTSBURGH & LAKE ERIE R.R. TERMINAL STATION, PITTSBURGH, PA.

the concourse or if they desire to pass through the station they have a covered walk, at the street level, that leads to the main entrance. They may then go down the stairway to the general waiting room, or take elevators to the offices above. Passengers arriving by public or private conveyance alight in the cab stand and reach the concourse by either of the two routes previously described for travel between the trainshed and cab stand, or alight under the protection of a porte-cochere at the Smithfield St. entrance to the station.

Fig. 3 shows an elevation and sections of the shelter spanning Smithfield St., the covered way leading to the station entrance, and the stairway to the platform and subways. Fig. 4 is a cross-section of the subway under Smithfield St., and Fig. 5 is a view of the station end of the subway. This subway is constructed of reinforced concrete, lined inside with white ceramic tile, with a dark

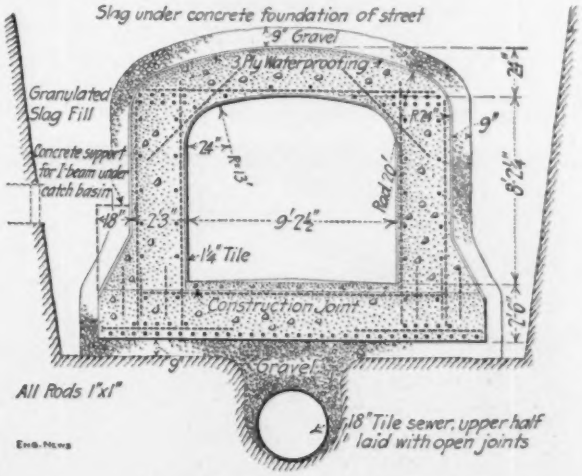


FIG. 4. CROSS-SECTION OF PASSENGER SUBWAY

ceramic-tile base, and granolithic-concrete floor. It is well lighted by electric lights. The heavy reinforcing and the spread of the footings was made necessary on account of the unstable foundation upon which the subway is constructed. Up to the present time, a little more than two years since the construction of the subway, no perceptible settlement has taken place nor have any cracks developed.

OTHER FACILITIES

DRINKING WATER—The sanitary drinking fountains, and the old-type drinking fountains from which water may be drawn for filling individual cups, are supplied with distilled drinking water, cooled by ammonia coils to 45° F. The water is kept in constant circulation by a small pump and returns through a pressure valve to a cedar storage tank so that a person does not have to allow the water to run, but may drink at once. The passenger coaches of all trains leaving Pittsburgh are stocked with distilled drinking water.

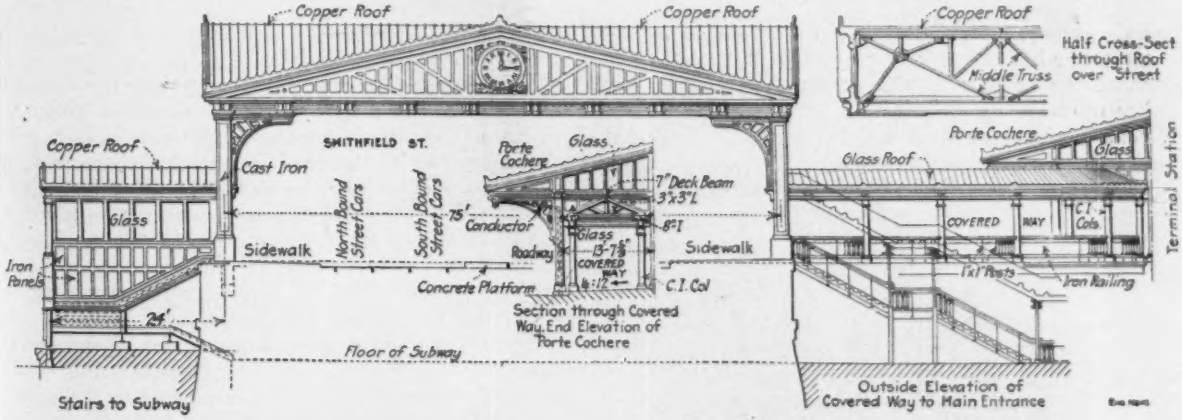


FIG. 3. SECTIONAL ELEVATION OF FACILITIES AT ENTRANCE TO PASSENGER STATION

VENTILATION—The ventilating system of the entire building, from which the passengers receive especial benefit in the waiting roms, is by means of a forced system of circulation. The air is freed from practically all extraneous matter by a washing process and is heated to the desired temperature in winter and cooled in summer. It is then discharged into the rooms approximately at the floor level. At the ceiling are outlets of the same area, which (also by means of forced circulation) draw the air from the rooms at a slightly less rate than it is being delivered. This keeps a slight excess pressure in the rooms, which tends to prevent dust or dirt from the outside getting through any crevice or opening that might exist around the window frames or through exterior doors when open.

This fresh air is delivered and exhausted in such quantities as to change the air in the rooms every 15 min. The window sashes are built in, one sash in each series being hung on hinges in order that the janitors may get outside to wash them. These windows are kept locked, the janitors having the keys.

GATEWAY RAILING—Fig. 6 shows a detail of the railings at the approach to the ticket gates between the concourse and train shed. This design differs from the ordinary practice in that the top or guard rail is not supported directly on the uprights. The arrangement permits a passenger to walk through the gate rails with a suitcase or valise, without the customary annoyance of striking his burden against the upright supports. At the same time it preserves a distance between the guard rails which insures only one person, at a time, passing through the gate.

FIG. 5. COVERED WAY AND STREET SUBWAY; PITTSBURGH & LAKE ERIE R.R. TERMINAL, PITTSBURGH, PA.

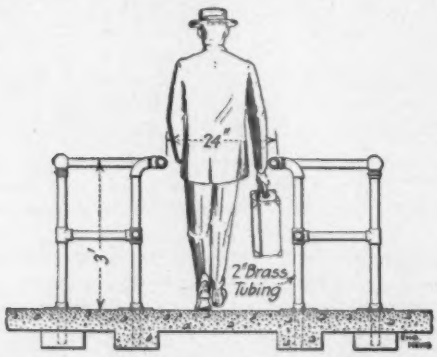


FIG. 6. ARRANGEMENT OF RAILINGS, AT ENTRANCE TO TRAIN PLATFORMS, ALLOWING SPACE TO CLEAR HAND BAGGAGE

PLATFORMS—The concrete platforms in the trainshed are 12¼ in. above the top of the rail, which makes the distance from the platform to the first step of the coach vary (for different classes of equipment) between nothing and 8¾ in. This easy rise avoids the necessity of stools being used to assist passengers in boarding or alighting from a train. In the platform protected by the umbrella shed, safety treads are built in the concrete at the edge of the platform (Fig. 2) in the location that a person would step in alighting from a train.

The terminal station building and facilities were designed in the office of the Chief Engineer, Pittsburgh, Penn.: J. A. Atwood, Chief Engineer: and A. R. Raymer, Assistant Chief Engineer.

Petroleum Production in the United States in 1912 and 1913 was 222,935,044 bbl. and 248,446,230 bbl., respectively. The average price per barrel in each case was $0.727 and $0.954, according to the United States Geological Survey. These figures show that while the gain in barrels was less than 26,000,000, the gain in value was almost $73,000,000. The output in 1913 was greater than in the previous year by more than 11%. Every state except Colorado showed an increase in the value of the oil. The greatest production districts were as follows, in the order named: California, Mid-Continent, Illinois, Appalachian, Gulf, Lima and Indiana, Colorado and Wyoming.

Annual Meeting of the American Society for Testing Materials

The 1914 meeting of the American Society for Testing Materials, held last week (June 30 to July 3) at Atlantic City, was fully as active as its predecessors, which means that it was the busiest engineering meeting of the year. It was distinctly marked by a drifting-apart of committee work and independent papers, evidenced by the fact that few of the papers related closely to subjects of specifications or other committee work. Part of this phenomenon is chargeable to the large amount of subcommittee work which the main committees now carry on. Thus the committee on Preservative Coatings for Iron and Steel has half a dozen or more subcommittees studying various phases of oil analysis, etc., and their results are incorporated in the committee report as small-print appendices, whereas formerly such auxiliary work might have furnished material for independent papers.

This, however, is part of a larger change in the society, which represents an important evolutionary stage.

Great Growth of Committees

The committees of the society are becoming so large as to constitute independent societies, so to say. One of them has 108 members, another 67 members, and several others have over 30 members each. They have their own officers, their own meetings, their own income (contributions solicited from manufacturers), and—as an innovation of the past year—their own constitutions or regulations.

But the most prominent mark of the commanding status of the committees is found in the fact that they have become self-perpetuating. So far as the society membership at large is concerned, the committees are virtually immortal. They control their own membership, and they can be discharged only at their own motion or with their consent, except "for cause," in which case the Executive Committee acts as judge and executioner. At least this is what appears from a new set of Regulations Governing Technical Committees, which are now in force, by virtue of having been promulgated by a special committee.

Another change just made is also a reflection of the magnitude and importance of the committee work. The terms of the officers of the committeees are now limited to two years, just as in the case of the society itself. This arrangement by itself suggests the permanent nature of the committees.

Power of the Membership to Be Limited?

Related to the preceding is a suggestion which Prof. Edgar Marburg (Univ. of Pennsylvania) made in a paper entitled "A Critical Review of the Procedure Governing the Adoption of Standards." He suggests that it is meaningless and undesirable to have the whole society vote on the adoption or rejection of specifications, standard methods, and the like. Committees made up of experts draw up such recommended standards, and the general membership of the society is probably incompetent to pass judgment on the specialized matters presented.

Prof. Marburg did not suggest an alternative; or rather he suggested several, in the form of queries—his paper was largely an assemblage of queries. But any alternative to the present method of taking a vote of the whole society, by letter ballot, on the adoption or revision of specifications, must be a move toward limiting the powers of the members.

The discussion which followed the reading of the paper made it clear that some members would object to a course of this kind. Sharply diverging opinions were expressed. Thus, R. W. Hunt (Chicago) called the letter ballot farcical, and claimed that all doubts or objections to a specification should be fought out on the floor of the society's meeting at the time the committee presents its report. On the other hand, Prof. A. N. Talbot (Univ. of Illinois) favored retention of the letter ballot, and boldly asserted that not all knowledge on a given subject is tied up in the committee which deals with that subject.

No action was taken in the matter, as no specific proposal had been advanced by the author.

Specifications for Engineering Methods

A radical innovation in the society's work presented itself during the meeting in the shape of a specification which, instead of defining a material, prescribed certain methods of engineering construction. So unobtrusively did this make its appearance that no word of comment was uttered, and with smooth dispatch the meeting adopted it for submission to letter ballot, which usually is equivalent to final adoption (no letter ballot having resulted in rejection, in the society's history).

The committee on Drain Tile reported (1) a set of methods for strength tests of drain tile; (2) a specification for quality of drain tile (strength only), and (3) a set of rules entitled "Proposed Recommended Practice in *Design and Construction* of Tile Drains." The latter contained very detailed prescriptions for bedding, backfilling and tamping; and, further, *a table of earth pressure on pipes* in trenches of various widths and depths, for sand and clay. Instructions for using the table, and factors of safety to be employed in designing tile drains, were also given.

Overnight consideration of this proposal resulted in a qualified reconsideration of the approval given these specifications the previous day. A resolution was passed which (1) directs the executive committee to consider the departure from prior policy involved in the formulation of rules on engineering design and construction, and (2) directs the executive committee and the drain-tile committee jointly to consider this question in its aplication to the present case. However, as no formal vote was taken to rescind the meeting's approval, the drain-tile specification will presumably go out to letter ballot in the usual way.

The most important or interesting of the committee reports are summarized below. Elsewhere we give some notes on new data or other useful information contained in the papers presented at the meeting.

Steel Committee

The formidable Steel Committee (108 members, 15 subcommittees) reported a large batch of revisions of existing specifications, and some new specifications. Of the 30 standard specifications previously worked out by the committee, only 14 remained unchanged. All the recommended changes and new specifications were accepted by the meeting and passed to letter ballot of the society. The most important changes are as follows:

Steel Rails

In the face of requests made on behalf of the American Railway Engineering Association to take no action on rail specifications now, the committee revamped its rail specifications thoroughly. It substituted a single specification for the two separate ones dealing with open-hearth rails and bessemer rails; increased the carbon (to a maximum of 0.62-0.75%, for openhearth rails over 85 lb. per yd.); extended the range of sizes down to 50 lb. per yd. and up to 120 lb. per yd.; adopted a ductility measurement in the drop test; abandoned a fixed ingot-discard; and fixed the standard rail length at 33 ft.

Bridge and Structural Steel

While still maintaining the distinction between bridge steel and building steel, the committee made some important changes. Among them are the following:

In *Bridge Steel.* Strength of rivet steel reduced 2000 lb., to 46,000-56,000 lb. per sq.in., and sulphur raised half a point, to 0.045%; a bend test for eye-bars added; tension tests from angles abandoned.

In *Nickel Steel.* Sulphur raised one point, to 0.05%; tension tests of angles abandoned.

In *Building Steel.* Strength of rivet steel reduced 2000 lb., to 46,000-56,000 lb. per sq.in.

A new specification for *Structural Steel for Cars* was drawn up. It calls for metal of 50,000 to 65,000 tensile strength, in plates and shapes over ⅛ in. thick. Parallel with it is the revision of the specification for *Structural Steel for Locomotives.*

Reinforcing Steel

In concrete-reinforcing steel rolled from billets, an intermediate grade was added, between the structural and hard grades. This grade is to have 40,000 lb. yield-point and 70,000-85,000 ultimate tensile strength.

Ductility and Ultimate Strength

In all the above, as well as in other specifications under charge of the steel committee, the elongation requirement will hereafter be made inversely proportional to the ultimate strength, i.e., per cent. elongation equals the quotient of a constant divided by ultimate strength. This calculation, evidently, takes account of the fact that, with the same original material, slight variations of physical condition will shift the strength and the ductility in opposite directions.

A particular application of this calculation led to a warm fight. The specification for *tempered axles* was revised in consultation with a committee of the American Electric Railway Engineering Association. That committee demanded, for electric-motor axles, a high ductility of fixed amount for all tensile strengths within the allowed range. The steel committee declined this demand and stuck to the inverse-ultimate rule. The fight was brought into the meeting, W. E. Johnson appearing for the A. E. R. E. A. committee. The society finally supported its steel committee, and passed the specification to letter-ballot.

All other specifications for railway forgings were also revised, and the revisions accepted by the meeting. A proposed standard method for chemical analysis of plain carbon steel was also accepted by the meeting.

C. D. Young (Pennsylvania R.R., Altoona, Penn.) is chairman of the committee.

Wrought Iron

Staybolt iron still occupies the wrought-iron committee (chairman, S. V. Hunnings, Schenectady, N. Y.). A minor change in the existing standard specifications was recommended, and was accepted by the meeting. Vibratory tests of staybolt iron cannot be included in the specifications, the committee reports, because the various testing machines do not agree.

Chain iron will be studied during the coming year. The subject of pipe threads will also be considered.

Cement: The Autoclave Test

The savage fight waged over the autoclave test at the 1913 meeting of the society resulted in the cement committee's finally entering upon consideration of this form of test. Preliminary arrangements have been made for a systematic trial of the test, in which 16 laboratories will assist. Of these 16, no less than 11 were already engaged in making such tests when the committee inquired about the matter.

The Force patent of Feb. 3, 1914, covering the autoclave method of testing cement, is a confusing element in the situation.

The International Association for Testing Materials has, during the past year, reorganized its committee on Accelerated Tests of Constancy of Volume of Cements. R. L. Humphrey (Philadelphia) is the new chairman of this committee. The autoclave test may receive consideration also by this committee.

Two other subjects will be dealt with by the American Society's cement committee during the coming year: the Chapman method of determining consistency, and a standard screen scale.

Lime

Two sets of specifications for lime, covering respectively quicklime and hydrated lime, were prepared by the lime committee for submission to the meeting. At the eleventh hour, however, the committee changed its mind, revised the specifications, and presented them only as tentative, not for present adoption.

These specifications give a classification of limes, limit the carbon-dioxide content, limit the coarse material, and, for hydrated lime, specify a soundness test. Strength requirements are not feasible, and other requirements which would define the product precisely are apparently not possible at the present time.

Drain Tile and Sewer Pipe

Two separate committees are handling specifications for drain tile and sewer pipe respectively. The latter has not yet drawn up a specification, but the drain-tile committee (chairman, Prof. A. Marston, Iowa) reported a group of three specifications on methods of test, quality of tile, and proper design and construction of tile drains.

Novel features of these specifications are:

Three methods of making a crushing test of drain tile are described and permitted on equal terms; the results are declared to have certain specified ratios. The strength as given by the sand-bedding method is made the standard of comparison, but the assumption is made that this method produces the same bending moment in every case.

Three qualities of drain tile are recognized. Of these, the highest grade must be vitrified salt-glazed clay tile or thoroughly seasoned concrete tile, but the other two

grades may be of any material. The grades are distinguished according to crushing strength, tables of strengths for various sizes being given for each grade.

The specification for design and construction of tile drains has already been mentioned. A factor of safety of 1½ is prescribed for ordinary tile-laying. A table of loads on pipe in trenches, as determined by tests, gives loads for depths of trench up to infinity, and widths up to 5 ft.

These specifications received no discussion at the meeting, but were passed to letter-ballot. A special resolution was passed at a later meeting (as previously noted), calling for consideration of the policy of adopting engineering rules.

The work of this committee is remarkable also for having included a very great amount of experimental work. Full reports of the experiments were published as Bulletin 34 of the Iowa State College of Agriculture & Mechanic Arts, quite recently.

The Sewer Pipe Committee (Chairman, R. Hering, New York) also proposes to draw up a specification for laying pipe, as part of its final report. A memorandum on this subject, and a glossary of technical terms, have been prepared, and were presented at the meeting as tentative.

Road Material, Brick, Cement and Waterproofing Committees Conflict

A set of proposed test methods for specific gravity and absorption of rock, and methods of mechanical analysis of broken stone, gravel, and sand were prepared by the Committee on Standard Tests for Road Materials. But the concrete committee protested that it should have a voice in formulating such methods, and the result was that the proposed methods were referred back, for conference of all interested committees. Definitions for certain terms relating to bituminous materials were also proposed, but here the waterproofing committee protested, and similar action was taken as in the other case.

This led to heated discussion when the brick committee presented a report of progress. The committee on road materials, which had just been treated as noted, made the claim that it should have a voice in considering paving brick. But Prof. A. H. Blanchard's vehement argument to this effect was ineffective, as the meeting voted against the claim.

Paint

The report of the paint committee (Preservative Coatings for Structural Materials) took the shape of a 125-page book. The committee has 67 members and 12 subcommitttees, and carries on a number of elaborate investigations. Detailed reports on laboratory studies of paint materials filled most of the book. Their subjects are: Tests of Chinese wood oil, 22 pages; Tests of linseed oil; Methods of analysis of white pigments and red lead, 20 pages; Turpentine, 28 pages; Other Thinners, 4 pages; Shellac, 7 pages.

Tentative specifications for turpentine, covering some of the properties of turpentine, were presented, but not for present adoption. Several other properties cannot be specified until additional test results are obtained.

A series of definitions of technical terms relating to paint was criticized by C. D. Rinald (Philadelphia), and finally was referred back to the committee for reconsideration.

The Havre de Grace Bridge Paint Test

Eight years ago the committee painted the Havre de Grace bridge, Pennsylvania R.R., with 19 paints. Now many parts of the bridge need repainting and the test is declared ended. On a rating of 10 = perfect, the inspection of the bridge May 1, 1914, showed 9 paints to be in condition meriting a rating of 5.0 or over. The two highest ratings are 8.1 and 7.2. The committee resolved not to make public any information as to the origin of the various paints.

Other Exposure Tests of Paints

The steel-plate panel tests with ocean-side exposure, at Atlantic City, started six years ago by the Paint Manufacturers' Association, has also come to a final end. The last inspection was May 2, 1914. The paint committee of the American Society for Testing Materials has coöperated in these tests. It reported the 1914 ratings of the panels that still survived, but for some unaccountable reason it did not offer a word of comment or conclusion.

White paints are being tested on a test fence in Washington, D. C. This test was started in 1912. Results (for 15 mo.) will be reported in our next issue.

New and Revised Specifications

Besides those noted above, three other new specifications were presented and were accepted by the meeting: Cold-drawn bessemer automatic-screw stock, which describes a dead soft steel of 0.08 to 0.16% carbon; recommended practice for the annealing of carbon-steel castings; hardened steel objects.

The following specifications were revised, more or less extensively: Standard magnetic tests of iron and steel; manganese-bronze ingots for sand castings; spelter; locomotive cylinders.

The committee on Methods of Testing reported a large series of recommended revisions in its specifications. Many of them were based on the use of three-point extensometers, which the meeting was not willing to accept as standard. All the recommendations were finally referred back.

Lubricants were also a subject of contention. Provisional tests for lubricants were presented for adoption. The Saybolt viscosimeter was made standard, though a minority of the committee demanded that the Engler viscosimeter be admitted as alternate. The split on this point resulted in the specification being referred back to the committee for reconsideration.

Progress Reports of Committees

Fireproofing materials are being studied, but further progress waits for extended tests which are to be made this year. One line of study will be materials suitable for furnishing short-time protection to columns and girders of buildings, at less cost than complete fireproofing.

The committee on rubber products has ceased work on air-brake hose but continues work on pneumatic-tool hose. Specifications are being drawn for cold-water hose, low-voltage insulated wire, packing, gaskets, pump-valves and steam hose.

Copper trolley-wire specifications form a subject of nonagreement between the society's committee and a committee of the American Electric Railway Engineering Association. It is proposed to collect data on trolley-wire service which may settle the differences.

The cast iron committee is working on revision of the malleable castings specifications, as the change in the business due to steel castings taking up the field of heavy castings is making better specifications necessary.

Brick is still in a tentative stage. The provisional specifications presented a year ago are not recommended for adoption, but elaborate tests on relation between strength and absorption, etc., will be made; 24 laboratories will coöperate in the work.

An elaborate progress report was presented by the committee on Sampling and Analysis of Coal. This is the result of joint work with the American Chemical Society, and is the second preliminary report on the work.

The Committee on Specifications for Timber proposes to undertake active work during the coming year.

The address of the retiring president, Arthur N. Talbot, was on the subject "The Relation between Research and the Activities of the Society." It was in part an earnest reminder of the fact that to make specifications and to formulate testing standards requires thorough knowledge of materials and their properties, and that to secure such knowledge calls for much and thorough experimental research. Obviously the society should stimulate research.

Possibly some day there may need to be a general research committee of the society to coördinate work and to stimulate opportunities. * * * Research requires patience, diligence and skill as well as knowledge and opportunity, from outlining the problem and separating the essentials from the non-essentials to analyzing the data and drawing conclusions. See that men of ability and training are selected for such work. Express appreciation of the results obtained and encourage extension of the work. For one function of the society is to widen our knowledge of materials.

In reviewing the available agencies of research the speaker attributed special importance to coöperative studies by committees of the society (and other societies) and laboratories of producers, consumers, independents and schools. One of the instances he cited is of particular interest, on the one hand because it involves exceptional difficulties, and on the other hand because the research will be largely Prof. Talbot's own work. This is the study of stresses in railway track, from roadbed up to rail, which has recently been put under way by the American Railway Engineering Association and the American Society of Civil Engineers.

New Officers

The terms of the principal officers expiring this year, A. W. Gibbs (Pennsylvania R.R.) was elected president, A. A. Stevenson, Vice-President, and Edgar Marburg re-elected secretary and treasurer. The new members of the executive committee are, Robert Job, F. W. Kelley, A. Marston, and S. S. Voorhees.

A group of amendments to the constitution, providing for selection of a nominating committee by the membership, was approved by the meeting and passed to letter ballot.

* *

Useful New Facts About Materials

News and Results Abstracted from Papers Read Before the American Society for Testing Materials

How Strong Is Steel under Repeated Stress?

Steel bridges, axles, springs, shafts, and a great variety of other structures and parts are called upon to endure many-times-repeated stresses. Their safety depends on the ability of the metal to endure stress-repetition or stress-reversals, rather than on strength under static test. Soft and ductile steel is safe in this respect, as past experiments have shown quite conclusively. But metal which has been partly hardened by cold working may be less safe, inasmuch as it is employed under stresses higher than soft metal could carry, although we do not know that it has greater endurance under repeated stress.

This is one and the most important of the queries propounded by Prof. H. M. Howe (Columbia University, New York) in a paper "Are the Effects of Simple Overstrain Monotropic"? The paper considers whether steel is hardened (its yield-point raised) in all directions when it is cold-worked in only a single direction. Some tests made at Columbia on the broken halves of a tension test-piece showed practically equal Brinell (ball-test) hardness in all directions. But in connection with this central subject the author deals with many related questions, among them the above-noted question as to strength under repeated and reversed stress.

Future experiments must settle this important doubt. At present we can do little more than guess. A few quotations from the paper are:

There is much evidence to show that reversing overstrain, instead of adding to any initial elevation of the elastic limit and tensile strength caused by prior overstrain, as simple overstrain does, for example in wiredrawing and cold-rolling, has the opposite result of effacing the effects of such overstrain. If this is true, then it follows that any rise of the tensile strength and elastic limit caused by prior overstrain is fictitious as regards the endurance of stress reversals, and that the effective fatigue strength is that which existed before such prior overstrain, and hence that to which the metal would return on removing that overstrain by annealing at 600° C.

This hypothesis . . . would imply that cold-rolled shafting, hard-drawn wire, and like materials, have no greater endurance than the same materials when annealed.

If it is true that stress reversals efface the elevation of the elastic limit due to prior overstrain, for example that caused by cool-rolling or forging, by quenching stresses, etc., then it seems to follow that engineering specifications for objects which in use are subjected to numerous stress reversals should ignore such elevation.

Is the elevation of the proportionality limit by cool-rolling, forging, etc., fictitious as regards stresses which, though varying within wide limits, yet remain constant in sign? I interpret Bairstow's evidence as arguing that it is.

Internal Fissures in Steel Caused by Defective Manufacture

A 10-in. locomotive driving axle broke while in the lathe, before it had been in service. Examination by Robert Job (Montreal, Que.) showed a large transverse fissure 8 in. in diameter, at the point of fracture, which left only a narrow ring of solid metal around the periphery. There were also some longitudinal cracks. The

steel contained 0.48% carbon, low phosphorus and sulphur, and was not segregated, nor did it contain excessive slag. Microscopic examination showed evidence of uneven heating, and overheating on one side. The case proves that an internal transverse fissure may be produced in metal at the mill and as a result of severe stresses induced by defective mill practice.

Prof. H. M. Howe suggested that such cracks probably result often from charging a cold ingot into a hot furnace. Snapping sounds are given out by such a piece as it heats up, suggesting that the cold interior is torn apart as the outside heats up.

An Accelerated Endurance Test for Metal Coatings

The protective value of galvanizing and other metal coatings has hitherto been largely subject to guess. Exposure tests are likely to vary in their conditions so greatly as to vitiate comparisons; the fact that they require a very long time before any results whatever are obtainable makes them inapplicable as routine acceptance tests. No accelerated test of general applicability had been devised. Now, however, a very promising test has been developed in the laboratory of the General Electric Co., and the company's testing engineer, J. A. Capp, described it under the title "A Rational Test for Metallic Protective Coatings."

The test consists in exposure of the test articles to a saturated salty atmosphere. An atomized spray of water saturated with common salt is projected into the chamber containing the articles. Rust appears very quickly, in times ranging from an hour or two to several weeks. This length of time is taken as measure of the protection afforded by the coating. The rusting usually is practically uniform over the whole surface of the article; when certain parts of the surface (as the edges of screw-threads on a threaded article) show rust much earlier than other parts, the coating is evidently thin or weak at these points.

The spray test (without salt) was first used as an accelerated test of insulations. In applying it as a rusting test to galvanized or sherardized articles, the simple water spray was too slow; by adding salt, much more rapid action was obtained. In this form it has been in regular use for several years past in the laboratory above mentioned.

When the coating is relatively thin and poor, rust may develop in from 2 or 3 hr. to 24 hr., or longer. A better coat will last two or three days, but a well applied coat of requisite thickness will last at least a week. If no rusting is developed in two weeks' time, it may safely be assumed that the life of the coating will be practically indefinite. These figures are based on experience with both sherardized and galvanized types of coating.

The standardization and adoption of such a test is likely to have a considerable effect in promoting the intelligent selection and use of metallic coatings.

Paint on Cement or Concrete Surfaces

H. A. Gardner (Washington, D. C.) adds materially to the few existing data on painting concrete. A two-year test of 35 different paint mixtures applied (3 coats) to separate panels of a cement-stucco test fence in Washington shows that good oil paints give very satisfactory service on cement surfaces, while water paints and varnish or other resinous paints do not. A priming coat of 25% zinc-sulphate solution was applied to the panels, to neutralize any free lime, but this is held to be unnecessary if the surface is dry when painted and will not be exposed to the weather. The oil paint is not attacked by the dry cement, and holds both texture and color. Boiled linseed oil, mixtures of raw and boiled oil, and mixtures with Chinese wood oil, gave equally satisfactory results. Such simple paint coatings were also found to be excellent for concrete floors, being durable, wear-resisting, and dust-preventive.

The Strength of Slag Concrete

Although much concrete made with blast-furnace slag as aggregate is in service (and has been in service for years), there are still many who doubt the strength and the permanence of such concrete. As to strength, new data have been provided by W. A. Aiken (Philadelphia). He started an extensive series of tests a year ago, making 500 six-in. cubes of 1:2:4 cement-gravel-slag mixture. The sand "was not what could be considered first-class material." Of the total number, 400 have already been tested; the other 100 are to be tested at future periods. The average crushing strengths obtained were, in pounds per sq. in.:

SLAG CONCRETE, AVERAGE WEIGHT 140.8 LB. PER CU.FT.

Age	28 d.	3 mo.	6 mo.	9 mo.	1 yr.
Crushing strength.....	1561	1952	2589	2841	2797

The author interprets these figures as follows:

The main point is whether the compressive-strength values herein developed are sufficiently great to warrant the employment of slag as aggregate, in competition with broken stone and gravel. We think the findings are in favor of this, since our experience has been that the crushing strength of broken-stone or gravel concrete, made up under ordinary field conditions, will not average over 1500 lb. per sq.in. at the age of 30 days.

Slag varies widely, both physically and chemically. That firm slag will make a strong concrete has never been much in doubt. Naturally, the discussion of the paper dealt with the permanence of slag concrete rather than its strength, although Mr. Aiken gave no data on permanence. Opposing opinions were expressed. R. L. Humphrey (Philadelphia) mentioned having examined many cases of disintegrated concrete made with blast-furnace slag. He claims that slag if suitable is excellent for concrete, while if unsuitable it is the worst material that can be used.

Expansion and Contraction of Concrete with Wetting and Drying

Experiments by Prof. A. H. White (Univ. of Michigan) reported three years ago showed that concrete expands by wetting and contracts by drying, in amount sufficient to affect structures quite seriously. Continuation of these experiments has shown that these volume changes do not decrease or stop with age. Further, bars cut from sidewalks after 20 yr. service also show these phenomena, and retain them even after baking at 600° F.

Progressive expansion or contraction may also occur. A bar of neat cement could by successive bakings be made to contract as much as 4.6%. Bars of 1:3 sand mortar could, by successive bakings and boilings, be made to elongate 0.75%. Bars cut from sidewalks taken up after 20 yr. service were made to elongate 0.175% by successive immersions in water at room temperature; it

would take 300° F. temperature rise to produce an equal heat-expansion.

Full data on these tests are given in Prof. White's recent paper "Volume Changes in Portland Cement and Concrete." The author suggests that the observed phenomena represent serious causes of destruction of concrete in service. But on this point the concrete men disagree with him heartily. They have asserted that his test conditions are artificial. The permanence of concrete pavements and sidewalks is claimed to be a sufficient answer to his allegations.

Additional Results Obtained with Autoclave Test for Cement

H. J. Force (D., L. & W. R.R., Scranton, Penn.) reported new figures on the relation of tensile strength, compressive strength, and air and water storage, to aging of cement-mortar testpieces. Tensile tests of 1:3 briquettes, tested up to 1 yr., do not show very marked influence of the ability of the cement to pass the autoclave test. But in the compression tests up to 1 yr., the cements which failed to pass the autoclave test were much lower than those which passed the test.

Briquettes stored in water for varying periods up to 2 mo., then tested by autoclave and broken in tension, showed that "seasoning" was frequently not obtained by the water storage. Many of the 2 mo. briquettes failed in the autoclave test; but cement which passed the test in 24-hr. briquettes did not fail in the test at subsequent periods.

Briquettes stored in air for 18 mo. were in some cases not "seasoned" with respect to the autoclave. But those which passed the autoclave test at 24 hr., and gave high tensile strength, also gave high strength after passing the autoclave at the age of 18 mo.

Test for Concrete Aggregate

C. M. Chapman (Westinghouse Church Kerr & Co., New York) has tried the following test of the value of broken stone, etc., for use as aggregate in concrete: A skeleton testpiece of the stone to be tested is formed by filling the stone into a mold and then filling the interstices with a standardized grout; then this skeleton testpiece is crushed at 14 or 28 days. The compressive strength so found is taken as a measure of the value of the stone.

In actual manipulation, the stone after first being soaked in water, is mixed with the 1:1 standard grout, the surplus grout drained off through a ¼-in. sieve; the stone so coated with grout is then put in the mold and shaken and packed down, and the rest of the grout poured in to fill all voids. A 6-in. cylinder 6 in. high is one of the shapes tried.

[*Other abstracts will follow in next week's issue*]

Test for Fireproofing. A test structure for conducting tests of fireproofing and fire-resistive coverings for structural members is being erected at the Underwriters' Laboratories, Chicago, the Factory Mutual Fire Insurance Companies coöperating in the enterprise. The test structure, it is claimed, will be "the most wonderful machine of the kind ever built." Temperatures will be measured with great accuracy. Many kinds of tests can be made. The Bureau of Standards may assist in conducting the tests.

A New City Charter for St. Louis

The city of St. Louis, on June 30, by a vote of 46,839 to 44,158 adopted the new charter prepared by the Board of Freeholders. The Board of Freeholders consisted of six lawyers, six business men and one engineer, Edward Flad, M. Am. Soc. C. E., for several years Water Commissioner of St. Louis.

The new charter provides for a single legislative body, a Board of Aldermen, consisting of 28 members. The Mayor is the chief executive and responsible officer, and appoints the administrative heads of all the departments. His salary is $10,000 per annum. He and all other elective officers are subject to recall. There are also the usual provisions for initiative and referendum. No recall petition can be filed within six months after an election.

Of the most interest to engineers is the Board of Public Service, which is appointed by the Mayor. This board is composed of a President and four Directors: the Director of Public Utilities, the Director of Streets and Sewers, the Director of Public Welfare and the Director of Public Safety, each the head of a Department of the same designation. The salary of each member of the board is $8000 per annum. According to Section 2, Article XIII,

> The President of the Board and the Directors of Public Utilities and of Streets and Sewers shall be engineers of technical training, of at least ten years' experience, and qualified to design as well as to direct engineering work.

The President of the Board has charge of any public works undertaken by the city which are not assigned to special departments. The Department of Public Utilities, which includes water-supply and city lighting, has general supervision over maintenance, equipment, operation and service. Under the new charter the city may buy and operate any kind of a public service. The water-supply is a subdivision under a Water Commissioner. The work of the Department of Streets and Sewers includes garbage and refuse collection and disposal, bridges, wharves and levees. The Department of Public Welfare includes parks, hospitals and penal institutions, including a division under the Health Commissioner. The Department of Public Safety includes police and fire-protection, weights and measures, and building inspection.

All subordinate employees are examined and selected by an Efficiency Board consisting of three members appointed by the Mayor. The Board may call on other persons to frame questions and conduct examinations or tests. Any appointing officer may suspend or discharge or reduce in rank any employee under him. So far it is merely a civil service board, but in addition to these powers it is also to investigate and keep a record of the efficiency of officers and employees in the classified civil service, and requires reports relative to employee's efficiency from appointing officers.

The purchases for all city departments are made through a Supply Division of the Department of Finance, which is distinct from the other city departments and is under the general supervision of a Comptroller elected by popular vote. The subordinate officers of the Department of Finance, the Assessor, Collector, Treasurer, and Supply Commissioner, are appointed by the Mayor. The Supply Division does not have jurisdiction over the purchase of material for public works and improvements.

The Largest Pumping Plant in the World: a Great Humphrey Engine Pumping Plant for Land Drainage in Egypt

The Egyptian government has just awarded to the Humphrey Pump Co., Ltd., of London, a contract for ten Humphrey direct-acting explosion pumps with a combined capacity of a billion Imperial gallons per 24 hours for use in drainage of the Nile Delta at Mex, Egypt. This will be, we believe, in volume of water handled, the largest pumping station in the world, if not at first then certainly when it reaches its ultimate size, as provision is to be made in the construction for the addition of eight more pumping units, giving it a total possible output of 1,800,000,000 gal. per 24 hours. In making comparisons, of course, it must be remembered that these are Imperial and not United States gallons.

The only pumping installation we can recall which might possibly compare in volume of water handled with this great Egyptian plant is some of the screw propeller pumps, built to force a current of water through a tunnel for flushing out river channels, such as the well known plant at Milwaukee. These screw-propeller pumps operate, however, under a very small head, whereas the Humphrey pumps at the Mex station will lift the water 19 to 20 ft. According to the information furnished to us, the purpose of this great pumping plant is to furnish drainage for a considerable part of the Nile Delta. The drainage from a large area of irrigated land flows into Lake Mareotis, beside which the station is to be built. The pumps will lower the level of this lake 7 ft. and will then maintain it at this lower level. Each pumping unit is to be designed for an output of 68,750 Imp. gal. per minute normal rating (100,000,000 gal. per 24 hr.), with an overload capacity of 75,625 Imp. gal. The pumps will be supplied with producer gas made in Dowson producers from anthracite coal. The contract awarded includes besides the pumps the necessary screens, sluice gates, etc., the gas producer plant, auxiliary gas engines and electric generators for power and lighting, and Venturi meters for recording the flow in the conduits. The accompanying cut gives a profile and cross-section of the new pumping station as now designed.

The great size of the pumps may be judged from the fact that each unit is to be capable of delivering more than double the amount delivered by each large Humphrey pump unit installed at the Metropolitan Water Board's Pumping Station at Chingford, which have an output of 40,000,000 gal. per day each.

The maximum internal diameter of the combustion chamber will be 8 ft. 8 in. and its height about 14 ft. The water valve box will be 8 ft. 8 in. diameter and 7 ft. high, and will be fitted with 100 valves of the hinge type specially designed to enable any valve to close upon an obstruction, such as a piece of wood, without throwing undue strain on the hinges. The design is such that on the next stroke, when the obstruction has been removed by the rush of water, the valve will automatically readjust its position and close fairly upon its seat. This type of valve has proved itself thoroughly satisfactory under test.

All the main castings will be of steel, and will be carried upon a cast-steel bend which connects to the playpipe. This bend will be in two parts, making up the 118.5° required to connect with the inclined playpipe.

At Chingford, the bend has an angle of 90° and connected to a horizontal playpipe, which in turn connected through a second 90° bend to a vertical conical water tower. At Mex, however, there will be only one bend, and the playpipe is sloped upward so as to deliver the water at the required elevation in the discharge basin. In order to reduce the velocity of the water at the exit, the playpipe ends with a long conical portion giving a 12-ft. diameter outlet. Not only does a sloping playpipe eliminate one of the bends and give rise to a simpler construction, but it has the additional advantage that the vertical components of the forces due to momentum of the moving masses of water in the combustion-chamber portion and playpipe portion, respectively, are balanced.

LONGITUDINAL SECTION THROUGH CONDUITS OF HUMPHREY GAS PUMPING STATION TO BE BUILT AT MEX, EGYPT

The pumps will be started by forcing into the combustion chamber a mixture of gas and air which is exploded by means of the usual sparking plug and switch so as to give rise to the first oscillation, after which the working becomes automatic. Compressors capable of rapidly charging the pumps for this purpose and having separate cylinders for air and gas are included in the contract.

Five of the pumps will be made by Wm. Beardmore & Co., Ltd., of Glasgow, and five by the Tecnomasio Italiano Brown Boveri at Milan.

The anthracite gas plant will be capable of gasifying 44 tons per day. There will be nine producers, one of which will be a spare.

There will be two Venturi meters supplied by George Kent, Ltd., each arranged to measure the water delivered from one or more pumps up to a total of five. These meters will be of square section and 12x12 ft. in the throat. The meters are guaranteed to be accurate within 1¼%. Except that the throat diameters will be lined with gun-metal to insure smooth and accurate stream lines they will be mostly constructed of ¾-in. steel plates bolted to rolled-steel joists and jointed with lead strips. The meters will be partly supported in the natural rock as excavated and partly by concrete walls.

The whole of the work will be carried out under the

supervision of Harper Bros. & Company, Consulting Engineers to the Egyptian Government.

We are indebted for the above information to the owners of the American rights to the Humphrey patents, the Humphrey Gas Pump Co., Syracuse, N. Y.

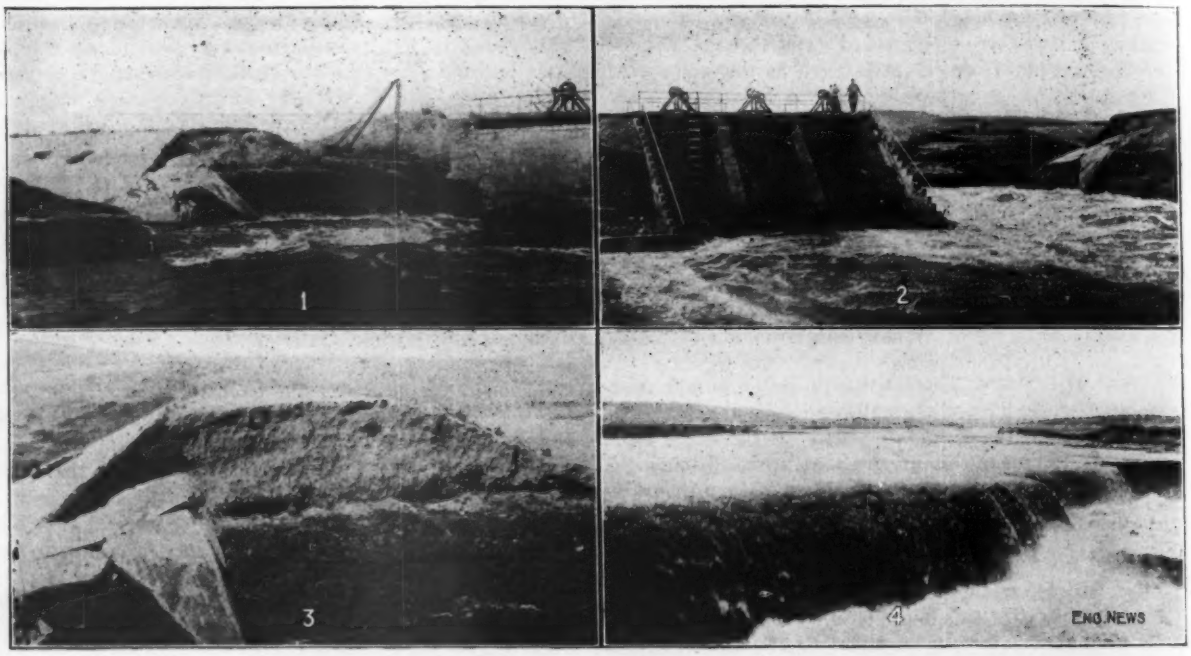
Reservoir Embankment Failure; Turlock Irrigation District, California

(CONTRIBUTED)

The break in the embankment of Davis reservoir, Turlock Irrigation District in Stanislaws County, Calif., was an accident of no little engineering interest so that available details should be put on record. The immediate damage to the irrigation works is comparatively small (possibly $50,000) but the loss to the community from crops ruined by the deprivation of water, may amount to a million dollars or more, if water is not quickly restored. However, a large force of teams was put at work immediately to construct a new canal where needed and the District officials hope to resume irrigation service in about 30 days.

CANAL AND RESERVOIR—The main canal of the Turlock Irrigation District heads on the Tuolumne River at the La Grange Dam about 28 miles east of Modesto. From the intake the canal runs generally west for 10 mi. and empties into Davis reservoir. This latter has what is locally known as a "foothill site," covering 3200 acres, and having a maximum depth of 39 ft. and a capacity of 47,000 acre-ft. It is formed by a series of earth dams with concrete facing, built last winter. The natural formation at this location consists of 30 or 40 ft. of fine sandy soil, and sand of various degrees of fineness which in places is cemented so as to form a hardpan. The outlet structure is located in a deep cut made through the latter material. In placing the outlet, which consists of three radial gates, a cut was made considerable wider than the structure itself and the backfill was dumped in wet and, some claim, not puddled. A 6- to 8-in. concrete facing was placed on the face of the fill and extended into the bottom hardpan several feet. This facing connected with the gate structure but the sides of that structure were made smooth without any cutoff walls or wings.

Water was first turned into the reservoir early in April before the reservoir structures were complete, and on June 27, the gage registered 38 ft.—nearly the full capacity. Soon after the reservoir was finished a number of water users protested against the acceptance of the works by the District, claiming that the filling had not been properly puddled and that the packing was cracking. There was reported a small leakage around the outlet structure. Some repairs were made but the leakage continued.



FIGS. 1 TO 4. VIEWS OF DAVIS RESERVOIR-EMBANKMENT FAILURE

(1) Upstream side of break at gate; (2) downstream side of break, depth of water 27 ft., flow 10,000 sec.-ft.; (3) embankment at break; (4) washout near river, working back at about 50 ft. per day—formerly a grain field 100 ft. above lower water.

THE FAILURE—At 2 a.m., June 28, the night watchman at the reservoir discovered that water was pouring through a hole on the right side of the gate structure, was rapidly tearing away the fill on that side and was cutting into the original hardpan sides. At 9 a.m., this gap had widened to 60 or 70 ft., and it is estimated that water was pouring through at the rate of 18,000 cu.ft. per sec. The water was carried by the canal a short distance and then broke its banks and overflowed into the Tuolumne River, finally cutting a deep, wide channel to the river, and washing out, beyond repair, about a mile of the canal. At this time (June 28) water is still flowing out and it will probably take several days to

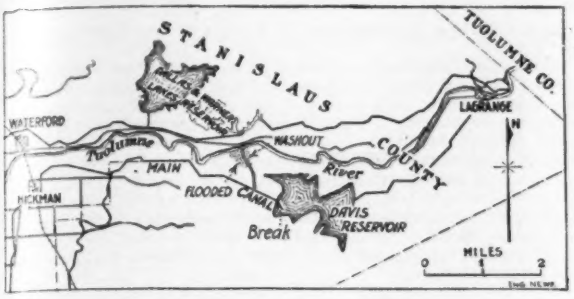


FIG. 5. MAP OF TURLOCK DISTRICT

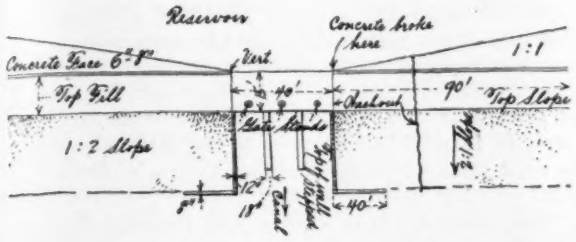


FIG. 6. SKETCH OF GATE STAND AND EMBANKMENTS AT BREAK (DIMENSIONS APPROXIMATE)

empty the reservoir. Figs. 1-4 show photographs taken on the morning of the 28th, when there was some 15,000 acre-ft. in the reservoir and about 10,000 sec.-ft. flowing out the break. Fig. 5 is a map of the district and Fig. 6 is a sketch, hastily drawn, of the gate and embankments.

CAUSE OF THE FAILURE

The cause of the break may be attributed to any one of several conditions which were found to exist.

(1) There was no provision for any cutoff wall on the side of the gate structure except the thin concrete facing. The structure presented a perfectly smooth surface and the new fill and small holes through the facing next to the wall would have led to an easy discharge path along this wall.

(2) The partly washed-out fill on the left side of the structure showed that it was composed of boulders, lumps of rock and hardpan and a fine sandy soil. Although it is claimed that this was puddled in place, some persons who witnessed the construction declare that the material was merely dumped from cars into a pool of water that was maintained in the center of the fill. The present exposed fill shows that the mass was not thoroughly compacted and not of very well selected material.

(3) The concrete facing on the fill is said to have extended 2 to 3 ft. into the hardpan on the bottom. When water was first placed in the reservoir and before it had attained any considerable head against this facing, leakage developed, which was apparently from under the fill. It is the opinion of some who watched the construction of the fill that this leakage was the cause of the failure.

A Proposed Deferrization and Demanganization Plant for the Lowell, Mass., Water-Supply

A novel water-purification plant for the removal of both iron and manganese from well water has been recommended to the city of Lowell, Mass., by F. A. Barbour, Consulting Engineer, Boston, Mass. The plans have been approved by the State Board of Health, and it is expected that bids for construction will soon be invited. The works have been designed for a nominal daily capacity of 10,000,000 gal., or a net average daily capacity of 7,500,000 to 8,500,000 gal. They include six coke prefilters, 10 ft. in depth and with a total area of 0.4 acre, to be operated as contact beds; a 500,000-gal. settling basin, in two units; 6 sand filters with a total area of one acre; and a 1,000,000-gal. filtered-water reservoir.

The nominal daily capacity of 10,000,000 gal. is based on a 75,000,000-gal. rate through the prefilter and a 10,000,000-gal. rate through the sand filter. The net rate mentioned allows for cleaning and for a possible lower rate of prefiltration. The estimated cost of the purification plant, low-lift pump to serve it and pipe connections is $180,000; to which $30,000 should be added for an extension of the well system to insure a supply equal to the capacity of the proposed purification works. The average cost of iron-and-manganese removal under these plans for the next 25 years is $7.65 per 1,000,000 gal., including interest, depreciation and operating charges.

Before deciding on the system of water treatment recommended, a long series of experiments was made on the removal of iron and manganese from the well water, and also another set of experiments on the decarbonation of water from another group of wells, the excessive carbon dioxide in which has given rise to lead poisoning and the consequent use of the wells only in times of high consumption. The design of the deferrization and demanganization plant was based on the experiments just mentioned. The decarbonation tests showed that the carbon dioxide could be removed by fine-spray aëration, in case it becomes desirable to use regularly the water.

In addition to the experiments with the well water, estimates were made of the cost of obtaining supplies from the Merrimac River, filtered, and from the Metropolitan water-works at the Wachusett Dam. The latter was found to be prohibitive in cost. A filtered supply from the Merrimac would cost about $250,000 for construction and $10.27 per 1,000,000 gal., including operating and capital charges. This is $2.62 more than the cost of iron-and-manganese removal, but the cost of maintaining the well system is estimated at $4.40 per 1,000,000 gal., which makes the filtered Merrimac supply less expensive by $1.78. Mr. Barbour considered this possible saving in cost more than offset by "the greater safety of the ground water, the lesser color, the lower temperature in summer, and the popular prejudice against the use of a polluted river water, however well purified."

TABLE SHOWING ANALYSES OF WATER SUPPLY OF LOWELL, MASS., FROM 1896 TO 1913.

Period	Color	Total solids	Ammonia		Chlorine	Nitrates	Nitrites	Oxygen consumed	Hardness	Iron
			Free	Albuminoid						
1896-00	15	44.2	0.087	0.032	2.7	0.261	0.001	0.7	17.6	0.322
1901-05	11	44.2	0.040	0.035	2.5	0.157	0.001	0.8	17.0	0.241
1906-10	25	42.7	0.131	0.048	2.8	0.098	0.001	1.1	18.5	0.770
1911-13	36	61.8	0.067	0.067	3.8	0.147	0.001	...	28.0	1.468

Deferrization and Demanganization Experiments

In 1893, Lowell put down a gang of driven wells in the valley of River Meadow Brook, known as the Cook Wells, and in 1894 put down another gang, a mile further upstream, called the Hydraulic Wells. Together these wells yield about 5,000,000 gal. per day. The State Board of Health having concluded that these wells would not yield more than half the amount of water needed by the city, a contract was let in July, 1895, for driven wells, two miles above the Pawtucket Dam, between the Merrimac River and the Boulevard—hence the name, Boulevard Wells. A total of 169 wells yielded about 4,000,000 gal. a day. In 1899, the Cook supply was condemned because of lead poisoning through the action of carbonic acid on lead pipes. In 1900 and 1901, there were added to the Boulevard system 177 wells, making 341 in all. In 1911, there were added 118 wells, bringing the total up to 459. In 1902 and 1903, the Cook wells were not used, but since then they have been used for short periods each year, to the extent of 3.2% of the total consumption in 1904 and 28% in 1913.

With the increased draft on the Boulevard wells the water has become turbid and colored, due to increasing amounts of iron and manganese—although it does not appear that manganese determinations were made until recently.

The five-year averages of chemical analyses (in table on page 107) of the Boulevard well water, made by the State Board of Health, are of interest as showing (particularly by iron and ammonia) the effect of "overworking the soil" from which the water is drawn (quantities in parts per 1,000,000):

It will be noted that although the last period is for three years, only the iron and other mineral contents showed a greater increase than in the five-year periods. It may be added that analyses made from August, 1913, to April, 1914, showed weekly averages ranging from 1.040 to 2.08 of iron and 1.7 to 3.55 of manganese (p.p.m.). Mr. Barbour states that with 1.6 parts of iron and 3.26 of manganese, 194.4 lb. of these two metals were being pumped into the water mains.

The 118 wells added in 1911 made "a temporary improvement in the quality of the supply, but within a few months, metal contents again increased to a point which rendered the supply disagreeable and altogether unsuitable for domestic service."

Experiments on this water were conducted with as much regularity as pumping conditions warranted from September, 1913, to April, 1914. Water was pumped to an overflow box, passed through an orifice to a prefilter and then to a sand filter provided with a rate controller. The desired rate of filtration was maintained by meters and daily calibration.

A series of 18 experiments is outlined and summarized in the report. We give here only the summary and conclusions, as follows:

The experiments above described indicate that the iron and manganese in the Boulevard water cannot be removed by aëration and direct application to sand filters, nor by aëration, sedimentation and sand filters.

That excessive aëration and the operation of the prefilter as a trickler is not adapted to the treatment of the local water.

That the iron and manganese can be successfully and economically removed by limited aëration, passage through a coke prefilter not less than 8 ft. in depth, operated as a contact bed at a rate of 67,500,000 gal. per acre daily, and subsequent filtration through sand at a rate of 10,000,000 gal. per acre daily.

On these conclusions, plans of a purification plant have been prepared, based on the use of coke prefilters 10 ft. deep, an intermediate sedimentation basin of 1 hr. capacity, and sand filters 3 ft. deep. The depths of both filters are greater than in the experimental apparatus, and the addition of the intermediate sedimentation basin will serve to reduce the work to be done by the sand filter. It is believed the experiments were sufficiently prolonged, and on such a scale as to permit safe conclusions to be drawn, and that there can be no doubt that the plant designed will successfully remove the iron and manganese and render the Boulevard supply entirely satisfactory.

Estimated Cost of Deferrization and Demanganization

An outline of the proposed plant and costs of construction and operation have already been given. The prefilters would be above ground, and apparently without a roof. The inner walls of the prefilter would be carried up and a roof thrown across to house the operating gallery. In front of this a headhouse and laboratory would be built from which the main operations of the whole plant would be controlled. Still farther to the front, the settling basins would be located, with the sand filters on either hand and the filtered-water reservoir in front. The settling basins, sand filters and filtered-water reservoir would all be underground, built of concrete, with groined arches.

Some of the unit construction costs are as follows: Earth excavation and embankment, 70c. per cu.yd.; concrete masonry, $9.50 per cu.yd.; steel reinforcement, 4c. per lb.; coke, $2.50 and gravel and sand each $2.25 per cu.yd. The recording apparatus complete is estimated to cost $3500.

The cost of treated water per 1,000,000 gal. has already been given as $7.65, as an average for the next 25 years. This is based on the following detailed estimate for a daily rate of 5,800,000 gal. in 1915 and 8,400,000 in 1940.

	1915	1940
Fixed charges at 6%	$10,800	$10,800
Fuel, low-lift pumping	2,870	5,130
Oil, waste, etc	320	425
Scraping, washing and replacing sand	275	400
Three filter attendants	2,460	2,460
Superintendence, laboratory maintenance	1,500	1,500
Total cost per annum	$18,255	$20,715
Cost per 1,000,000 gal.	8.60	8.75
Cost without fixed charges per 1,000,000 gal.	3.51	3.24

The present Holly pumps would lift the well water to the coke prefilters and two new steam-turbine-driven centrifugal pumps, located in a small extension to the present pumping station, would lift water from the filtered-water reservoir into the force main leading to the West St. pumping station.

James H. Carmichael is Commissioner of Water and Fire Protection of the city of Lowell, and Robert H. Thomas is Superintendent of Water-Works.

Proposed California Law to Regulate Expert Testimony

Oscar C. Mueller, attorney, of Los Angeles, Calif., in collaboration with others, has drawn a proposed code to regulate the testimony of experts in trial cases, which has been approved by various professional organizations and will be presented to the next legislature by Mr. Mueller.

who is chairman of the committee on amendment of laws of the Los Angeles Bar Association. The following is the text of the proposed law:

Whenever it shall be made to appear to any court or judge thereof, either before or during the trial of any action or proceeding, civil or criminal, pending before such court, that expert evidence is, or will be required by the court or any party to such action or proceeding, such court or judge may, on motion of any party, or on motion of such court or judge, appoint one or more experts to investigate and testify at the trial of such action or proceeding relative to the matter or matters as to which such expert evidence is, or will be, required, and such court or judge may fix the compensation of such expert or experts for such services if any, as such expert or experts may have rendered, in addition to his or their services as a witness or witnesses, at such amount or amounts as to the court or judge may seem reasonable.

In all criminal action and proceedings, such compensation so fixed shall be a charge against the county in which such action or proceeding is pending and shall be paid out of the treasury of such county on order of the court or judge. In all civil actions and proceedings such compensation shall, in the first instance, be apportioned and charged to the several parties in such proportion as the court or judge may determine and may thereafter be taxed and allowed in like manner as other costs.

Nothing contained in this section shall be deemed or constructed so as to prevent any party to any action or proceeding from producing other expert evidence as to such matter or matters; but where other expert witnesses are called by a party to an action or proceeding they shall be entitled to the ordinary witness fees only and such witness fees shall be taxed and allowed in like manner as other witness fees.

Any expert so appointed by the court may be called and examined as a witness by any party to such an action or proceeding or by the court itself and, when called and examined by the court, may be cross-examined by the several parties to the action or proceeding in such order as the court may direct. When such witness is called and examined by the court, the several parties shall have the same right to object to the questions asked and the evidence adduced as though such witness were called and examined by an adverse party. Whenever the expert or experts so appointed are called to testify, the court may, in its discretion, advise the jury, if there be one, that such expert or experts had been appointed by the court to make the necessary examination and testify as expert witnesses. The court or judge may, at any time before the trial or during the trial, limit the number of expert witnesses to be called by any party.

NEWS NOTES

A Cave-in in a 6-ft. Trench in Los Angeles, on June 25, severely injured a workman caught in the trench.

A Dynamite Explosion on a Government Dredge at Smithsonia, Ala., on the Tennessee River, on June 26, killed seven men.

A Boardwalk Collapsed dropping 50 persons into the river at Stag Island, on July 1. No one was injured. The walk led over water to a dock.

An 80,000-lb. Blast was shot at Colton, Calif., on July 4, according to press dispatches. The blast was for the purpose of getting out limestone for cement.

A Ship's Gangplank Broke in Charlestown, Mass., on June 30 and fell upon the crowd of people below, killing one man and injuring four others just before the White Star Liner "Cimric" sailed for Liverpool.

Broken Tackle dropped 40 tons of steel turbine casing to the deck of the new Argentine battleship "Rivadivia" at the docks of the Fore River Shipbuilding Co., Quincy, Mass., on June 29, according to press dispatches.

A Canadian Pacific Steamer Grounded on the rocks at Bad Neighbor Island, near Cove Island, on the night of July 1, in a fog. Sister ships speedily reached the "Assiniboia," 5000-ton flagship of the railway fleet, and commanded by Commodore McConnel. Early on July 3 her cargo was taken off by lighters and the steamer floated. She proceeded under her own steam to Port McNicoll.

A Large Flywheel Burst, shutting down for 24 hr. the plant of the Union Brewery, St. Louis, Mo., at 1.25 a.m., on June 29, with damage amounting to about $50,000. A segment of the 24-ft. 8-ton flywheel shot through the 4-in. concrete ceiling, breaking the ammonia pipes in the condensing room above. At the same time, steam pipes were broken, shutting down the plant. It is said that the speed of the wheel increased from 40 r.p.m., normal speed, to several times this speed before bursting.

A Loose Rock in a Deep Shaft of Section 3, Bayonne, N. J., of the Passaic Valley sewer, now under construction, fell to the bottom, killing five of a gang of thirteen muckers, at 9 p.m., July 3. The shaft was at one end of the siphon under Newark Bay; the other end is in Newark. The inside diameter of the shaft after the 18-in. concrete lining has been placed is to be 12 ft. It will be 250 ft. deep, and had been sunk to a depth of 230 ft. at the time of the accident. The shaft was through firm rock and was not timbered. The main piece which fell weighed about 5 tons, and dropped from a point in the wall about 75 ft. above the bottom. There was no blasting going on at the time and no other shock is reported. The fall was probably caused by intersecting seams in the rock. According to the New York & New Jersey Constructing Co., New York City, the shaft is inspected or scaled for loose rock every day, and had been thus inspected by the foreman one hour before the slippage. The large size of the loose section probably accounted for its not being discovered.

A Gas Explosion in the New Water-Works Intake Tunnel, Milwaukee, Wis., injured 21 workmen of a gang of 30, at 7.30 a.m., Monday, June 29. No work had been done in the tunnel on the previous day, which accounted for the large accumulation of gas. The explosion was probably caused by a lighted match or a spark struck by a drill. The tunnel was not damaged.

The tunnel, described in "Eng. News," July 24, 1913, p. 155, and June 18, 1914, p. 1354, is of brick lined with concrete and has a diameter of 12 ft. It will extend into Lake Michigan a distance of 4000 ft. to a crib from which four lines of 6-ft. cast-iron water mains will extend to a point 2500 ft. out in the lake where the water is 60 ft. deep. Work is going forward rapidly. The tunnel is divided into compartments and it was in the farthest out of these, 2050 ft. from the shore shaft, that the explosion occurred. The work is not done under compressed air, although an emergency air-lock has been provided. The crib was to have been sunk in place June 29.

The City-Manager Plan for Seattle, Wash., was defeated by a heavy majority at a popular election held on June 30.

The Proposed Naval Dry Dock at Norfolk, Va., which was in the preliminary Naval Bill before this Congress, has been rejected in the final bill. Provision was made in the bill for the rental from the Union Iron Works of a new dry dock to be built at San Francisco and to be capable of taking care of any boat which can pass the Panama Canal.

Pavement Construction by Municipal Day Labor has been decided upon in Kalamazoo, Mich. The city council has decided to purchase a complete plant for building concrete and brick pavements. It is expected to construct about $20,000 worth of concrete pavements and a $10,000 reinforced-concrete bridge by municipal labor during the present season.

A Municipal Paving Plant is soon to be put in operation by the Canadian city of Edmonton, Alta. It is planned to lay about 100,000 sq.yd. of asphalt and concrete pavements during the present season by municipal day labor. The plant will be operated in competition with contractors. The entire paving program for the present season involves an expenditure of $1,500,000.

Petty Grafting in the Public Works Department of Detroit, Mich., has been unearthed by the new Commissioner of Public Works, George H. Fenkell, M. Am. Soc. C. E., and 25 teamsters have been discharged. These teamsters are alleged to have pocketed thousands of dollars from the sale of old wood paving blocks, which were the property of the city. The blocks were sold for fire wood.

A Comprehensive Sewerage Scheme for North Toronto, Ont., has been recommended by the Commissioner of Public Works, R. C. Harris, of Toronto, of which North Toronto has become a part. The approximate cost of the proposed combined system is $4,144,256, including many miles of large trunk sewers and a sewage-disposal plant. The estimated cost of a sep-

arate system of sanitary and storm water sewers for the same area was $6,425,846.

Railway Terminals in Foreign Cities are to be investigated by the new Railway Terminals Commission, of Chicago, which commission is composed of representatives of the city and of certain civic organizations. The party is expected to include some of the aldermen who are members of council committees whose work is related to the problem of improving the railway terminals and facilities. The party will sail from New York on July 14 and is expected to return in September.

Concrete Road Construction in the United States, according to the "Bulletin on Concrete Roads," published by the Universal Portland Cement Co., has increased from 364,000 sq.yd. laid in 1909 to 19,200,00 sq.yd. which will be laid during the season of 1914. This area to be laid in 1914 is nearly double that laid in 1913, and over ten times the yardage laid in 1911. The yardage for 1914, above noted, which doubtless includes city streets as well as country roads paved with concrete, would be equivalent, if laid in one stretch, to a roadway 12 ft. wide and 2700 miles long.

Instruction in Public Health, Sanitary Science and Preventive Medicine.—A committee to study and to report to the university authorities what courses in these subjects should be given in the College of Physicians and Surgeons and in other departments of Columbia University has been appointed by President Butler. Among other members the committee embraces E. R. A Seligman, Professor of Political Economy, Chairman of the Committee; D. D. Jackson, Assistant Professor of Civil Engineering; Dr. Hans Zinsser, Professor of Bacteriology; and Dr. Walter Bensel, formerly Sanitary Superintendent of the New York City Health Department; Robert E. Chaddock, Associate Professor of Statistics.

Sanitary Protection of the Water-Supply of Interstate Vessels—The U. S. Treasury Department has amended the interstate quarantine regulations administered by the Public Health Service by adding the following paragraph governing the water-supply of ships:

No person undertaking to furnish water for drinking or cooking purposes to any vessel in any harbor of the United States, intending to clear for some port within some other state or territory of the United States or the District of Columbia, shall furnish for such purpose water taken from the waters of such harbor, or from any other place where it has been or may have been contaminated by sewer discharges. Any person violating this regulation will be liable to a penalty of not more than $500, or imprisonment for not more than one year, or both, at the discretion of the United States District Court.

The Purchase of the Property of the Spring Valley Water Co., of San Francisco, may be effected by agreement with the company instead of by condemnation. A valuation of the plant has been completed by M. M. O'Shaughnessy, City Engineer, who states that such of the property as the city needs for water-supply purposes is worth $34,500,000. It is thought probable that the officials of the city and the company will agree to submit the question of purchase at this figure to popular vote. If approved by the people, the condemnation proceedings entered upon some time ago will, of course, become unnecessary. We understand that a number of Eastern engineers have been at work for both sides in preparation for the condemnation proceedings.

A World's Concreting Record—What is believed to be a world's record in mixing and placing concrete for mixers of 1 cu.yd. capacity was accomplished on the Arrowrock Dam during April, 1914. The record is as follows:

Total yardage for the month	45,700
Number of hours per shift	8
Number of shifts per day	2
Number of hours per day	16
Number of 1-yd. mixers	3
Number of mixer hours per day	48
Number of working days in April	26
Number of mixer hours in April	1,248
Number of mixer hours delay	165
Number of mixer hours, delays deducted	1,083
Average yardage per day	1,758
Average yardage per 1-yd. mixer per day	586
Average yardage per 1-yd. mixer per hour, delays deducted	42.2

A $200 Prize for the Best Thesis on House Plumbing or the materials used for plumbing systems has been offered to the students of the Harvard University and the Massachusetts Institute of Technology. The offer was made by Waddill Catchings, a Harvard graduate of 1901, who is now President of the Central Foundry Co. The conditions of the competition have been briefly outlined as follows:

The subject must be approved in writing by Prof. Geo. C. Whipple before Nov. 1, 1914. The thesis must contain from 5000 to 10,000 words, exclusive of tables and drawings, and must be handed in on or before May 1, 1915. These must be typewritten and three copies furnished. Awards will be made by a committee appointed by Prof. Whipple and Gifford LeClear, Lecturer on the Mechanical Portions of Buildings in the Harvard Department of Architecture. In making the award special consideration will be given to theses based on original investigations.

Sub-Basement Stores or Salesrooms, made practicable by the deep foundations of some of the large store buildings in Chicago, are prohibited by city ordinance as being dangerous (in case of fire) and unsanitary. The ordinance limits the depth to 20 ft. below the street grade, but one new store building has a sub-basement 30 ft. below the street. The Health Department brought suit against the owners, and after a municipal court judge had decided against the city, the case was appealed to the Illinois Supreme Court, which has rendered a decision upholding the ordinance. It was argued that a fire in a crowded store two floors below the street would be extremely dangerous, while investigation has shown that it is practically impossible to secure adequate ventilation at such depths and in floors occupied by crowds of people. Such floors are liable to be damp, and the employees would have to work continuously under conditions of artificial light and ventilation.

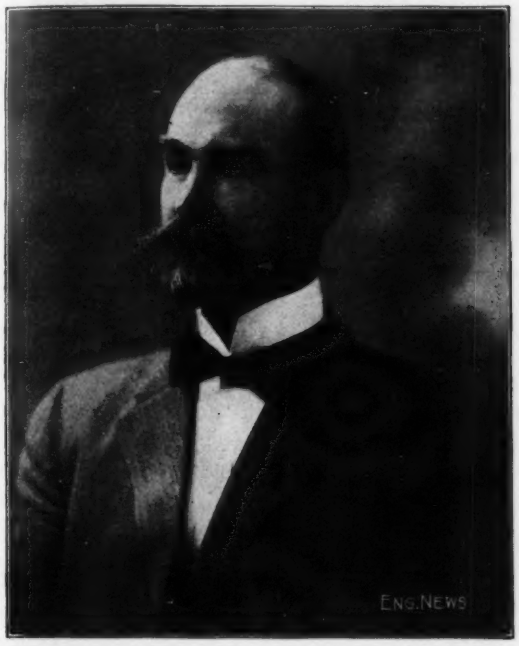
The Eruption of Lassen Peak, Calif., began, May 30 at 5.30 p.m. with an outburst of steam, which, according to Forest Supervisor W. J. Rushing, continued about 10 min., forming a crater in the snow-covered summit above 25x40 ft. and covering the snow for a distance of 300 ft. with dark, wet dust. Geologist J. S. Diller, in a report to the United States Geological Survey, stated that on the following day, at 8 a.m., another eruption occurred, followed on June 8 by a third and heavier one lasting 30 min. In all there were 11 eruptions to June 21. The most violent was at 9 a.m., June 14, which was visible from the Sacramento Valley, nearly 40 mi. away. The eruptions are usually preceded by a complete cessation of escaping steam. By June 20 the crater was 400x100 ft. by about 100 ft. deep. The ejected dust appears to be disintegrated or pulverized dacite and is produced by the pulverizing action of the explosive gases on the rocks through which they escape, and is not the result of the explosive expansion of gases in a liquid lava.

The Relative Importance of Different Seaports of the United States is shown by the statistics in the annual report on Commerce and Navigation for 1913, just issued by the Department of Commerce. The total foreign trade of the United States, including both imports and exports, now amounts to four and one-quarter billion dollars in round numbers, of which about two billion dollars were handled through the port of New York. The second seaport of the United States, however, is now Galveston, through which $290,000,000 worth of goods passed last year. New Orleans comes third with $252,000,000 worth; Boston fourth with $216,000,000; Philadelphia fifth with $170,000,000; Baltimore sixth with $150,000,000; San Francisco seventh with $130,000,000; Puget Sound ports eighth, $114,000,000; Buffalo ninth, $81,000,000; Detroit tenth, $71,000,000. In the total foreign trade amounting to $4,279,000,000 last year, the exports exceeded the imports by $653,000,000. The value of manufactured goods exported was more than six times as great as the imports of manufactured goods.

The Salem Conflagration caused the largest loss ever experienced by the Massachusetts Mutual Insurance Companies of New England. The Naumkeag cotton mills, which were in the area swept by the conflagration, were wholly destroyed with a loss of about $800,000. Although the area burned over, some 250 acres, was closely covered with dwellings and various business buildings, about one-third of the value destroyed was contained in this one factory plant. The buildings themselves were well protected with automatic sprinklers, etc., and although surrounded by the built up area which was swept by the fire, the exposure risk was not considered serious. The mills bordered Salem Harbor, and comprised six principal buildings, separated by broad open spaces. The flames and sparks from the conflagration, however, were carried toward the mills from a burning area over a mile long and a third of a mile wide. The terrific heat from this conflagration was driven by the wind against the front of the mills, about a quarter of a mile in length. This occurred when the conflagration was near its end, when the city water pressure had been reduced almost to zero by drafts of fire engines and the broken pipes. A few men of the factory's own fire organization fought the fire valiantly with the mill's two big fire pumps, which took their water supply from the harbor, but the heat and smoke were so severe that effective action was impossible.

PERSONALS

Mr. Merritt Haviland Smith, M. Am. Soc. C. E., recently Deputy Chief Engineer of the Board of Water Supply, City of New York, has been appointed Chief Engineer of the Department of Water Supply, Gas and Electricity, to succeed Mr. J. M. de Varona, M. Am. Soc. C. E., resigned as noted in our issue of last week. Mr. Smith was born in New York City in 1862 and graduated in civil engineering at the Pennsylvania Military college in 1880. For three years he was in the engineering department of the Pittsburgh & Western R.R. on survey and construction work. In 1884 he first became connected with the public works of New York City as a chief-of-party on surveys for the New Croton Aqueduct. Later he served as Assistant Engineer under the



MERRITT H. SMITH

Resident Engineer in charge of maintenance, repairs and operation of the Old Croton Aqueduct. During 1890 and 1891 he was engaged in engineering work in Florida. Mr. Smith returned to New York City in 1892 as Assistant Engineer of the Finance Department of the City, and the following year he was appointed Engineer on Repairing and Principal Assistant Engineer of the Department. During the Spanish-American War he received nine months' leave of absence from his city office, and during this period he served as Captain and Major of the First United States Volunteer Engineers in the Porto Rico campaign. He was appointed Department Engineer, Board of Water Supply, City of New York in 1906, and had charge of the Southern Aqueduct Department. Subsequently he was promoted to be Deputy Chief Engineer.

Mr. W. C. Lyon has resigned as Chief Inspector of the Rockford, Ill., city water department and will move with his family to Florida.

Mr. Frank Ernst has resigned as Sewer Commissioner of Moundsville, W. Va., to accept a position with the engineering department of the Wabash R.R.

Mr. J. R. Kearney, former Superintendent of Transportation of the Baltimore & Ohio R. R., has been promoted to be General Superintendent of Transportation.

Mr. Alan P. Wilson has been appointed Western Sales Manager of the Blaw Steel Construction Co., of Pittsburgh, Penn., with headquarters in the Peoples Gas Bldg., Chicago, Ill.

Mr. Thomas E. Murray, F. Am. Inst. E. E., Vice-President of the New York Edison Co., New York City, has been elected a member of the Board of Trustees of the Emigrant Industrial Savings Bank, New York.

Mr. E. W. Bemis has been appointed by Mayor Harrison, of Chicago, to succeed Mr. George Weston, M. Am. Soc. C. E., as the city's representative on the Board of Supervising Engineers which is in charge of the local traction affairs.

Mr. E. M. Scofield, M. Am. Soc. C. E., President of the Scofield Engineering Co., Philadelphia, Penn., has been appointed Vice-President of the Texas Southern Electric Co., owning and operating public utilities in Southern Texas.

Mr. George A. Greenslade has resigned as General Superintendent in charge of terracing operations on the east bank of Culebra Cut, Panama Canal, and is now in New Orleans, La. He expects to return to the Canal Zone to engage in private business.

Mr. James E. Taussig, recently Superintendent of Transportation of the Texas & Pacific Ry., Dallas, Tex., has been promoted to be General Superintendent to succeed Mr. J. W. Everman, resigned, as noted eleswhere in these columns. Mr. Taussig's former position as Superintendent of Transportation has been abolished.

Prof. R. J. Potts, head of the department of highway engineering at the Agricultural and Mechanical College of Texas, has resigned, effective Aug. 1. Prof. Potts has formed a partnership with Messrs. Charles E. Moore, of Waco, Tex., and W. Fred Smith, of Dallas, Tex., under the firm name of the Potts-Moore Gravel Co., with offices at Waco.

Mr. Charles H. Motsett, former Superintendent of the New York division of the New York, New Haven & Hartford R.R., is now Superintendent of the Panama R.R., with headquarters at Colon, Panama. Before going to the New York, New Haven & Hartford R. R. in 1908 most of his experience was with the Chicago, Rock Island & Pacific Ry.

Mr. W. W. Follett, M. Am. Soc. C. E., for the past 12 years Consulting Engineer of the International Boundary Commission, United States and Mexico, has resigned. His present address in 414 El Paso and Southwestern Bldg., El Paso, Tex. Mr. Follett received the honorary degree of Master of Engineering at the recent commencement of the University of Michigan.

Mr. Chas. E. Weidman, former Chief of the Division of Fire Protection of the Panama Canal Zone, has left the Isthmus for his former home in Lincoln, Neb., where he was Chief of the city fire department before going to Panama in 1905. Since Apr. 15 of the present year, the Division of Fire Protection, Panama Canal Zone, has been merged with that of Police and Prisons.

Mr. L. H. Shoemaker, M. Am. Soc. C. E., recently Engineer in charge of design, American Bridge Co., Pittsburgh, Penn., has been appointed Division Engineer of the Pittsburgh division of the company, succeeding Mr. Richard Khuen, Jr., M. Am. Soc. C. E., transferred to the erecting department. Mr. Shoemaker graduated from the University of Michigan in 1897. He joined the staff of the American Bridge Co. in 1901 as an Estimating Engineer.

Mr. H. G. Hamett has been appointed Chairman and Mr. William Hutton, Jr., Secretary of a Harbor Commission, recently appointed by the Mayor of the City of Troy, N. Y. The Commission contemplates the development of the harbor, the construction of warehouses, concrete bulkheads, slips and piers; all made necessary to care for the expected increase in traffic when the New York State Barge Canal is completed. It is expected that a Consulting Engineer and a Traffic Manager will be appointed to act with the Commission.

Mr. John W. Everman, formerly General Superintendent of the Texas & Pacific Ry., Dallas, Tex., has been promoted to be Vice-President and General Manager of the St. Louis & Southwestern Ry. of Texas, with headquarters at Tyler, Tex., succeeding Mr. W. N. Neff, resigned. Mr. Everman is a native of Philadelphia, Penn., where he graduated from the public high school in 1876. For two years he was engaged in mining work in Venezuela. In 1879 he entered the service of the Pennsylvania R.R. The following year he joined the operating staff of the Texas & Pacific Ry.

Lieut. George R. Goethals, Corps of Engineers, U. S. A., who has been in charge of the building of the Panama Canal Fortifications, under the immediate supervision of his father, Col. Geo. W. Goethals, Chief Engineer of the Panama Canal, has completed his work on the Isthmus and has been detailed to the Military Academy at West Point as Instructor. The fortifications have been constructed with the utmost secrecy, and probably no engineers but Col. Goethals and his son are familiar with all the works. The forts on the Atlantic side have batteries of 14-in. guns, 12-in. mortars and 6-in. guns, while those on the Pacific side have in addition one 16-in. gun, according to press dispatches.

Messrs. Frederic H. Fay, Chas. M. Spofford, M.'s Am. Soc. C. E., and Sturgis H. Thorndike announce the formation of the firm of Fay, Spofford & Thorndike, Consulting Engineers, 308 Boylston St., Boston, Mass. Mr. Fay has been Division Engineer of the Department of Public Works of Boston for several years past and has had charge of the design, construction and maintenance of all city bridges and the operation of the city ferries. Prof. Spofford is Hayward Professor of civil engineering at the Massachusetts Institute of Technology, and he will continue in this capacity, devoting only a portion of his time to the new firm. Mr. Thorndike until recently was Designing Engineer of the Department of Public Works of Boston under Mr. Fay. The new firm will specialize in the design of structures in steel and masonry, including superstructure and foundation, and river and harbor work.

Mr. I. M. de Varona, M. Am. Soc. C. E., whose resignation as Chief Engineer of the Department of Water Supply, Gas and Electricity was noted in our personal columns of last week, has been connected with the Greater New York water-works for nearly 32 years. His first work was in Brooklyn in 1882, when he was placed in entire charge of the surveys for the extension of the works from Rockville Center to Massapequa, the purchase of the property, the preparation of plans and specifications, and later the construction of the water-works with the exception of the Milburn reservoir. In 1894 he was appointed Engineer of Water Supply of the City of Brooklyn, and as such he was in charge of the collection, extension, distribution and pumping systems. For eight years following Mr. de Verona was chiefly interested in developing the driven well system, which is the chief source of the Brooklyn water supply. This work was continued until the total underground supply was increased from 17 millions to 130 million gallons daily. In 1897 he established the Prospect laboratory for the study of the prevention of water pollution, one of the pioneer plants of its kind. In 1902 he was promoted to be Chief Engineer in charge of the entire water-works system of Brooklyn, and in this capacity entirely remodeled the distribution system of Brooklyn, thereby adding greatly to the effectiveness of the fire protection of the city. Mr. de Varona planned and constructed the first infiltration gallery system for collecting the subsurface water on Long Island in 1903. He designed the high-pressure auxiliary fire protection system of Brooklyn in 1904, and subsequently, in 1905, when similar systems were planned for the other boroughs of Greater New York, Mr. de Varona was appointed Chief Engineer of Water Supply of the Boroughs of Manhattan, the Bronx, Queens and Richmond, continuing in charge at Brooklyn as Acting Chief Engineer. In 1910 the operation of the water-works of all the boroughs was consolidated into the Department of Water Supply, Gas and Electricity, and Mr. de Varona was appointed Chief Engineer. Some of his most notable work here has been in water waste prevention; it is estimated that the systematic campaign conducted under his direction has saved the city nearly 100 millions of gallons per day out of a total of 500 millions per day. The cost of operating the system has been reduced $1,000,000 per annum. The more important works recently prepared have been the plan of the utilization of the Catskill supply fo rall the boroughs; the design of the connections between the Catskill and existing systems in the Boroughs of Manhattan, The Bronx and Brooklyn; the by-passing of the Central Park reservoirs; the tunnel under the Harlem River, so as to make an additional connection between the Bronx and Manhattan; the study of the pumping of the Croton gravity supply to provide adequate pressure in Manhattan and The Bronx; a tabulated statement of the present and prospective revenue of the water-supply system of Greater New York, referred to the period between 1913 and 1925; the present worth of the whole water-supply system of Greater New York, and the study of the reorganization of the Bureau of Water Supply on a functional basis. Mr. de Varona has also been consulted on water-works problems by numerous other cities.

OBITUARY

Charles Roger Rundle, a retired contractor, of Toronto, Ont., died June 28, aged 71 years.

Harry F. Herman, a retired contractor, St. Louis, Mo., committed suicide, June 24, by shooting himself in the stomach with a shot-gun. He was 48 years old and is survived by a widow and one son.

Russell Pardee Orcutt, formerly Division Engineer of the Erie R.R. at Rochester, N. Y., died at Hot Springs, Ark., June 28, aged 29 years. He was the son of George N. Orcutt, Assistant to the President of the Erie R.R.

George T. McLaughlin, a contractor, of Pittsburgh, Penn., was drowned in the Allegheny River, near Hulton, on June 28. He was swimming near his summer home.

Alexander Stewart, General Superintendent of Motive Power and Equipment of the Southern Ry., Washington, D. C., died June 28, in Paris, France. He was 46 years old. He was born in Fort Wayne, Ind., and began his railway experience as a machinist's apprentice on the Union Pacific R.R. He was promoted in the service of the Union Pacific to be Master Mechanic at Cheyenne, Wyo. In 1903 he left the West to enter the employ of the Southern Ry. as Division Master Mechanic at Knoxville, Tenn. He was successively promoted to the highest office in the mechanical department within three years. He was a delegate to the International Railway Congress at Berne, Switzerland, in 1910, and was prominent in the railway mechanical associations.

ENGINEERING SOCIETIES

COMING MEETINGS

OHIO ELECTRIC LIGHT ASSOCIATION.
July 16-19. Annual convention at Cedar Point, Ohio. Secy., D. L. Gasgill, Greenville, Ohio.

AMERICAN ASSOCIATION OF RAILROAD SUPERINTENDENTS.
Aug. 20-21. Annual meeting in New York City. Secy., E. H. Harman, Room 101, Union Station, St. Louis, Mo.

AMERICAN PEAT SOCIETY.
Aug. 20-22. Annual meeting at Duluth, Minn. Secy., Julius Bordollo, 17 Battery Place, New York City.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION.
Sept. 1-4. Annual convention in New York City. Secy., J. D. Farasey, E. 37th St., and Erie Ry., Cleveland, Ohio.

AMERICAN MINE SAFETY ASSOCIATION.
Sept. 7-10. Annual meeting in New York City. Secy., H. M. Wilson, Bureau of Mines, Pittsburgh, Penn.

NATIONAL ASSOCIATION OF PORT AUTHORITIES.
Sept. 8-10. Annual convention in Baltimore, Md. Secy., Wm. Joshua Barney, 29 Broadway, New York City.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA.
Sept. 8-11. Annual meeting at Chicago, Ill. Secy., L. C. Ryan, Sterling, Ill.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 8-11. Annual convention in Nashville, Tenn. Secy., A. P. Dane, Reading, Mass.

NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 9-11. Annual convention in Boston, Mass. Secy., Willard Kent, Narragansett Pier, R. I.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.
Sept. 15-18. Convention in Atlantic City, N. J. Secy., Clayton W. Pike, Electrical Bureau, Philadelphia, Penn.

ILLUMINATING ENGINEERING SOCIETY.
Sept. 21-25. Annual convention in Cleveland, Ohio. Secy., Joseph D. Israel, 29 W. 39th St., New York City.

RAILWAY SIGNAL ASSOCIATION.
Sept. 22-24. Annual convention in Bluff Point, N. Y. Secy., C. C. Rosenberg, Times Building, Bethlehem, Penn.

Ohio Electric Light Association—The 20th annual convention of the Ohio Electric Light Association will be held at Cedar Point, Ohio, July 21-24. The Secretary is D. L. Gaskill, Greenville, Ohio.

Roadmasters and Maintenance of Way Association of America—The association will hold its annual meeting in Chicago, Sept. 8-11 at the Auditorium Hotel. The Secretary is L. C. Ryan, Sterling, Ill.

American Mine Safety Association—The next annual meeting of the association will be held in New York City, Sept. 7-10 at the Waldorf Astoria. The annual field meet will take place at Terre Haute, Ind., Sept. 7-12. R. Dawson Hall of "Coal Age," 505 Pearl Street, New York City, will be in charge of the local management of the New York meeting. The Secretary is H. M. Wilson, Bureau of Mines, Pittsburgh, Penn.

Canadian Electrical Association—The 24th annual meeting of the Association was concluded at the Ritz-Carlton Hotel, Montreal, Que., on June 26. The following officers were elected for the ensuing year: President, Col. D. R. Street, Secretary-Treasurer of the Ottawa Electric Co.; Vice-Presidents, D. H. McDougall, of Toronto, R. M. Wilson, of Montreal, and Wills MacLachlan, Toronto; Secretary, Allan Sullivan, Toronto.

The index for Vol. 71, January-June, 1914, will be mailed all subscribers to ENGINEERING NEWS in the issue of July 16.